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NEW ENGLAND DIV APR 79

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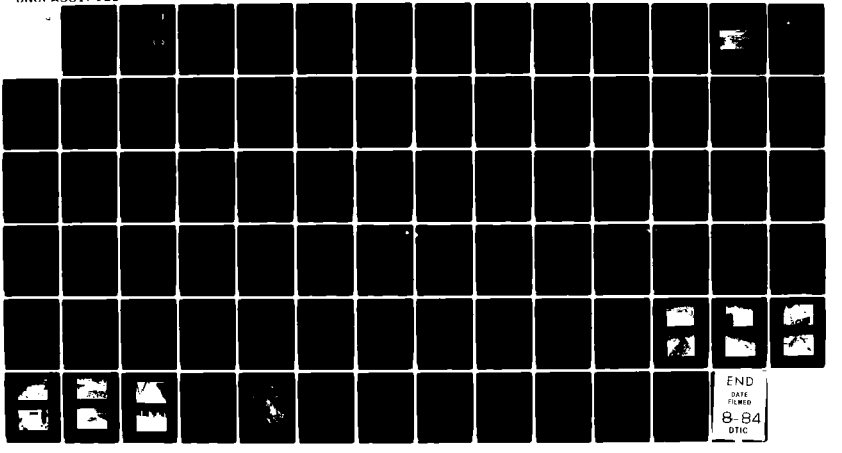

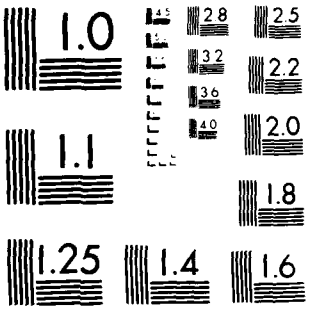

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The impounding structures at Willett Pond include a 900 ft.long, 25-ft. high main dam with a spillway and an outlet, and a 1,900 ft. long, 13 ft. high dike. The structures were built in 1913. The dam & the dike contain a concrete core wall with the embankments madd of earth fill. The crest of the main dam varies from elevation 143.7 to 144.6 and the crest of the dike varies from 142.0 to 142.8. The spillway is located at the south abutment of the dam, and consists of a three-bay concrete box culvert beneath the roadway. The combined width of the culvert openings is 24.9 ft., and the openings are each 5.1 ft. high. Water discharges into a 220 ft. long discharge channel lined with stone and concrete.

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WILLETT POND DAM

MA 00169

NEPONSET RIVER BASIN
NORWOOD/WALPOLE,
MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION
PROGRAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

BRIEF ASSESSMENT

Identification No.: MA00169

Name of Dam: Willett Pond

Town: Norwood and Walpole

County and State: Norfolk County, Massachusetts

Stream: Hawes Brook - Tributary of the Neponset River

Date of Inspection: December 5 and 12, 1978

The impounding structures at Willett Pond include a 900-foot long, 25-foot high main dam with a spillway and an outlet, and a 1,900-foot long, 13-foot high dike. The structures were built in 1913. According to the available specification and drawings, both the dam and dike contain a concrete core wall with the embankments made of earth fill. The crest of the main dam varies from elevation (El) 143.7 to 144.6, and the crest of the dike varies from El 142.0 to 142.8. An asphalt-paved street (Brook Street) is on the crest of the main dam. The spillway is located at the south abutment of the dam, and consists of a three-bay concrete box culvert beneath the roadway. The combined width of the culvert openings is 24.9 feet, and the openings are each 5.1 feet high. Stoplogs are mounted at the upstream end of the spillway. The crest of the stoplogs is at El 139.0 and the crest of the spillway is El 137.7. Water discharges into a 220-foot long discharge channel lined with stone and concrete. The outlet consists of two 20-inch diameter, cast-iron conduits which discharge at the toe of the dam. The pipes are located about 270 feet from the south abutment of the dam. A gatehouse on the downstream slope of the dam contains gate valves to control flow. Discharge from the outlet flows through a Parshall flume and into a flat swamp at the toe of the dam.

There are deficiencies which must be corrected to assure the continued performance of this dam. This

conclusion is based on the visual inspection of the site, a review of available data, a review of the 1911 and 1913 plans and specifications, and a review of operating and maintenance procedures. Generally, the dam is in fair condition.

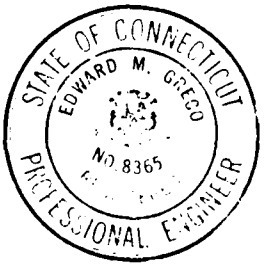
The following deficiencies were observed at the main dam: seepage at several locations along the downstream toe, erosion on the upstream face of the dam which has caused undermining of the crest, erosion on the upstream and downstream slopes due to surface runoff from the road on the crest, trees and brush on the upstream and downstream slopes, cracking and spalling of gunite and concrete on the spillway, debris lodged on the stoplogs of the spillway, erosion in the floor and in the north side of the spillway channel, trees on the sides of the spillway discharge channel, and standing water in the foundation of the gatehouse. Also, the earth dike is eroded locally on the upstream slope and contains trees and brush on the upstream and downstream slopes.

Based on Corps of Engineers' guidelines, the dam has been classified as "intermediate" and in the "high" hazard category. Accordingly, a test flood equal to the full probable maximum flood (PMF) was used for this analysis. Hydraulic analyses indicate that the spillway (without stoplogs) can discharge 740 cubic feet per second (cfs) with the pond at El 142.1, which is the average low point on the crest of the dike. A test flood outflow of 4,380 cfs (the full Probable Maximum Flood (PMF)) with the pond at El 143.6 will not overtop the main dam, but will overtop the dike by a maximum of 1.5 feet. The spillway (without stoplogs) can discharge 17 percent of the test flood outflow before the dike is overtopped. With the stoplogs in place, the spillway can discharge 440 cfs or 10 percent of the test flood before the dike is overtopped.

It is recommended that the Owner employ a qualified consultant to evaluate the seepage which is occurring through the embankment of the main dam. The consultant should also conduct a more detailed hydraulic/ hydrologic study to evaluate raising the crest of the dike or increasing the discharge capacity of the spillway at the main dam. The Owner should immediately remove the stoplogs in front of the spillway and lower the pond by an arbitrary 2.7 feet (to El 135) below the crest of the spillway to reduce seepage pressure through the dam. The pond should be maintained

at El 135 until the above recommendations and the following remedial measures are completed: repair erosion on the upstream slope of the dam and dike, construct surface drainage control on both sides of the crest of the dam; selectively clear trees and brush from the dam, dike, and spillway discharge channel; repair concrete/gunite on the spillway; repair erosion in the floor and a breach in the side of the spillway discharge channel; and dewater the foundation of the gatehouse and determine the location and magnitude of the leakage. The Owner should also implement a regular program of inspection and maintenance and a warning system for the dar

The remedial measures outlined above and in Section 7 should be implemented by the Owner within a period of one year after receipt of this Phase 1 Inspection Report. There are no recommended alternatives.



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Vice President
Metcalf & Eddy, Inc.

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No. 19703

This Phase I Inspection Report on Willett Pond Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

FRED J. RAVENS, JR., Member
Chief, Design Branch
Engineering Division

SAUL C. COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in Recommended Guidelines for Safety Inspection of Dams, for a Phase I Investigation. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions willbe detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general conditions and the downstream damage potential.

WILLETT POND DAM

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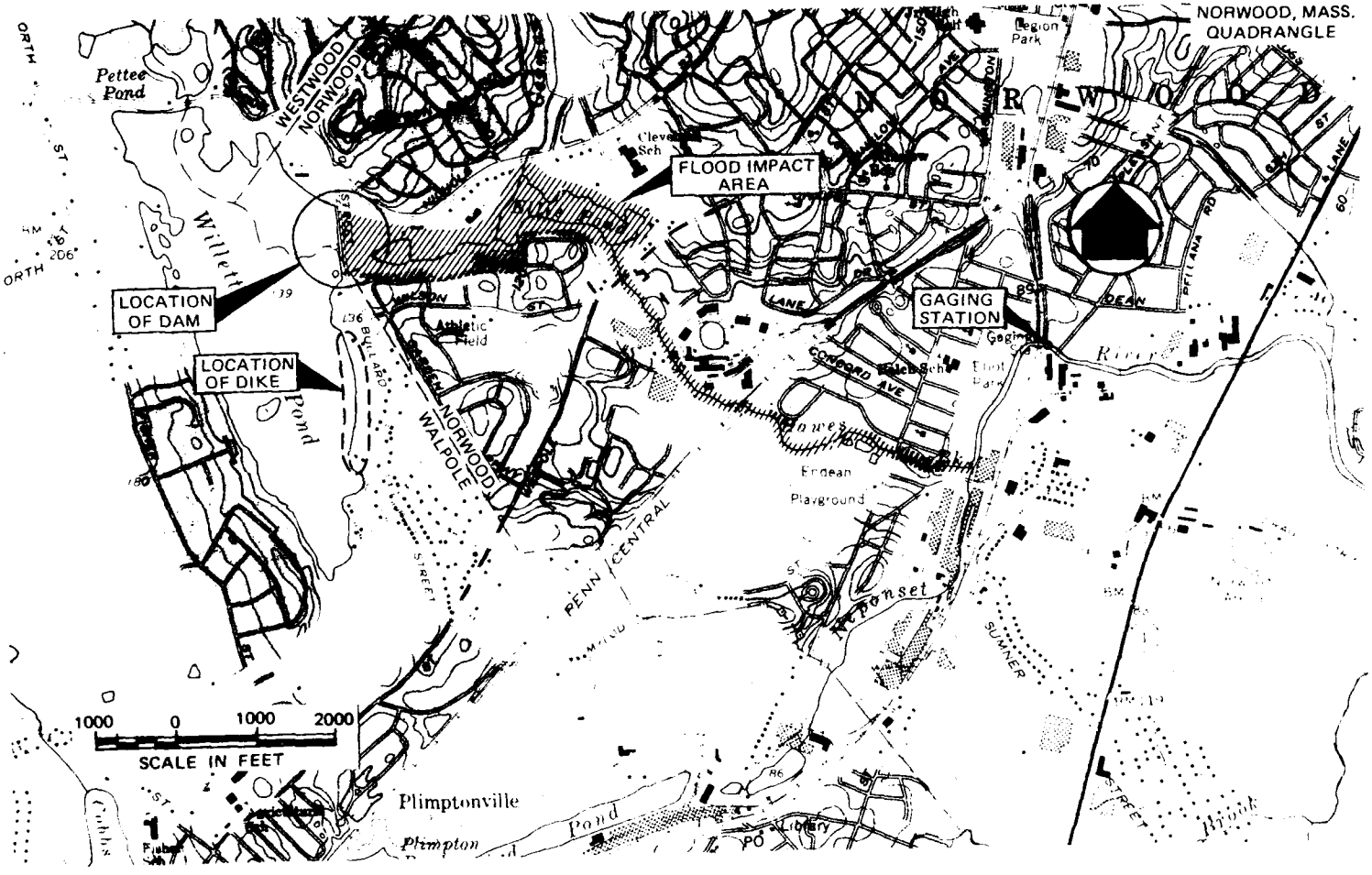
OVERVIEW
WILLET POND DAM
NORWOOD, MASSACHUSETTS



LOCATION MAP – WILLETT POND DAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

WILLETT POND DAM

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, dated August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Divison of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Metcalf & Eddy, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Contract No. DACW 33-79-C-0016, dated November 28, 1978, has been assigned by the Corps of Engineers for this work.

b. Purpose:

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.

(3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. The dam is located on Hawes Brook, a tributary of the Neponset River. The town line

between Norwood and Walpole crosses the axis of the dam (see Location Map). Most of the main dam is located in the Town of Norwood and the southern end of the main dam and the dike are in the Town of Walpole. These towns are located in Norfolk County, Massachusetts.

b. Description of Dam and Appurtenances. The impounding structures at Willett Pond Dam consist of the main dam, including a spillway and outlet, and an earth dike (see Figures B-1 through B-5 and photographs in Appendix C).

The main dam is a 900-foot long earth embankment with a maximum height of 25 feet at the gatehouse. According to the specifications and drawings for the dam, the embankment contains a concrete cutoff wall extending 4 to 10 feet below the base of the embankment (see Figures B-4 and B-5). An asphalt-paved street is on the crest of the dam, which is 23 to 27 feet wide. The crest of the dam varies from El 143.7 to 144.6. The section of the road located in Norwood is called Brook Street, and the section in Walpole is called Bullard Street. The upstream face slopes at 2:1 (horizontal to vertical) and is covered with riprap. The downstream face slopes at 2.0:1 to 2.5:1 and is covered with grass and vegetation. There is an area of rock and earth fill on the downstream face of the dam about 250 feet north of the gatehouse. This may have been the site of a tannery which was originally located at the dam.

The spillway, located at the south abutment of the dam, is a three-bay concrete box culvert which extends under Bullard Street. The approach to the spillway has vertical, concrete sidewalls extending 11 feet upstream. Wooden stoplogs are set at the entrance to the spillway, with the top at El 139.0. The invert of the culvert forms a broad-crested weir at El 137.7 at the upstream edge, sloping to El 136.6 at the downstream edge. The culvert openings are 5.1 feet high and have a combined width of 24.9 feet (effective length of spillway). The discharge channel below the spillway is about 220 feet long and 20 to 24 feet wide. The

sides are concrete walls for a distance of about 40 feet downstream. Below that, the sides are made of earth which are covered with boulders that are grouted in place. The floor of the discharge channel slopes at about 8 percent.

The low-level outlet for the dam consists of two 20-inch diameter, cast-iron conduits, extending from the upstream toe of the dam to the downstream toe. The outlet pipes are located about 270 feet north of the south abutment of the dam. The downstream invert of the pipes is at El 118.7. A brick gatehouse is located on the downstream slope of the dam and contains a manually operated gate valve and a gated bypass for each outlet pipe. The outlet pipes discharge into a Parshall flume used to measure the volume of flow (see Figures B-6 and B-7). A device to record flow is located inside the gatehouse. Below the flume is a stream bounded by trees and a swamp.

The dike is a 1,900-foot long earth embankment located along the southeast shore of Willett Pond (see Location Map). The dike has a maximum height of 14 feet. According to the specifications and drawings for the dike, the embankment contains a concrete core wall about 15 feet high. The crest of the dike is about 15 feet wide and varies from El 142.0 to 142.8. The upstream face slopes at about 2:1 and is covered with riprap. The downstream face slopes at 2.4:1 and is covered with vegetation.

c. Size Classification. Willett Pond Dam is classified in the "intermediate" category, since it has a maximum height of 25 feet and a maximum storage capacity of 2,785 acre-feet.

d. Hazard Classification. The valley downstream of the dam is about 400 to 500 feet wide. An earth dam 5 feet high is located about 800 feet downstream, but it has been breached near the south abutment down to the stream bed. A second dam forming Ellis Pond is located about 3,700 feet downstream of Willett Pond Dam.

Concentrated residential development occurs downstream of the dam along both sides of the valley (see Location Map). Most of the homes are built away from and at least 10 feet above the bed of Hawes Brook. However, some homes are lower and closer to the stream, especially along the south side of the valley on Morningside and Orleans Roads and around Ellis Pond. Below the dam at Ellis Pond, Hawes Brook flows beneath Route 1A, and then through a thickly developed area including an apartment building and a complex of factories.

The alignment of the dike is parallel to Bullard Street which is a well-traveled road. About 20 residences are located downstream, about 200 and 500 feet from the dike.

Failure of the main dam when the pond is at the crest of the dike would produce a flood wave about 10.5 feet high, 1,500 feet downstream. It is likely that this flood could result in excessive property damage and the loss of more than a few lives. Discharge below the Ellis Pond Dam could also affect the roadway and structures farther downstream. Failure of the dike would produce a flood wave 3.5 feet high and would cause excessive property damage and possible loss of life along Bullard Street. Accordingly, the dam has been placed in the "high" hazard category.

e. Ownership. The dam and dike have been owned since November 1953 by the Neponset Reservoir Corporation, a group of four industrial companies located along the Neponset River. The member companies are: Bird & Son, Inc., East Walpole; Hollingsworth & Vose Co., East Walpole; the Kendall Co., Walpole; and Diamond International, Hyde Park. The current chairman of the corporation is Mr. Malcolm White at Hollingsworth & Vose Co., 112 Washington Street, East Walpole, Massachusetts 02032 (telephone: (617) 668-0295). Mr. White granted permission to enter the property and inspect the dam.

The pond originally was referred to as New Pond but is now known as Willett Pond, out of respect for George F. Willett, former president

of Winslow Brothers & Smith Company, under whose administration the man-made pond was constructed.

f. Operators. The dam is operated by personnel from Bird & Son, Inc., East Walpole.

g. Purpose of Dam. Willett Pond was originally used by Winslow Brothers and Smith Co. to provide water for processing at a tannery. Later, the water was reportedly used to dilute industrial effluent from Hollingsworth & Vose Co. and Bird & Son, Inc., but who now recycle their industrial wastewater.

At the present time, water in Willett Pond is primarily used to maintain a flow of 3 mgd (million gallons per day) in the Neponset River as measured at a gaging station located about 2 miles downstream. The water is released as needed, usually during July and August. The pond is also drawn down in the fall to provide storage for spring runoff. The pond is also used for swimming and boating by the abutting residents.

h. Design and Construction History. The dam and dike at Willett Pond were constructed in 1913 for Winslow Brothers and Smith Co. A drawing and construction specifications were prepared in 1911 by Lucian A. Taylor, consulting engineer (drawing shown on Figure B-5). A later drawing of the dam was prepared by A. L. Maddox, engineer, in 1913 (see Figure B-4). These drawings show that both the dam and dike were to be constructed with a concrete core wall extending below the bottom of the embankment. The base of the core wall is described as carried to bedrock or to a "watertight foundation". The specifications state the embankment was to be constructed of "good gravel and sand such as may be procured from the neighboring land". The spillway was to be constructed of concrete with the crest four feet below the top of the embankment of the dam. The outlet pipes are shown as two 20-inch diameter, cast-iron pipes encased in concrete and having gate controls at the toe of the dam.

During the period 1953 to 1970, several plans were proposed for diverting water from Willett Pond and Hawes Brook to ponds near the Hollingsworth & Vose and the Bird & Sons factories. None of these plans was ever implemented.

In 1971, a Parshall flume was constructed below the outlet pipes for measuring discharge into Hawes Brook. Construction drawings prepared by Metcalf & Eddy, Inc. are shown on Figures B-6 and B-7.

Spalling and cracking of the concrete had been described in inspection reports dated May, 1968 and July, 1973. Therefore, in about 1975, the concrete walls of the spillway were reportedly reconstructed by the Owner.

i. Normal Operating Procedures. Personnel from Bird & Son, Inc. reportedly visit the dam three to four times a week. The stoplogs on the crest of the spillway are permanently mounted; therefore, operation of the dam consists of opening and closing the gates on the outlet pipes. The gates are operated in summer and early fall, as required, to maintain a flow of 3 mgd at a gaging station located 2 miles downstream on the Neponset River (see Location Map). Personnel from Bird & Son, Inc. have keys to the gaging station and check the flow periodically during dry months. The pond is also drawn down by 2 or 3 feet in the fall to provide storage for runoff in the spring. Maintenance personnel measure discharge through the Parshall flume and record the discharge using an instrument located in the gatehouse. The gatehouse is kept locked.

1.3 Pertinent Data

a. Drainage Area. The approximately 3,555-acre (5.55 square mile) drainage area includes the drainage areas of Bubbling Brook and Mill Brook which flow into Willett Pond from the north (see Figure D-1 in Appendix). The topography is gently rolling. About 12 percent of the drainage area is ponds and swamps. The remaining land is about half wooded and about half cleared, mostly for residential development. There is moderate to thick residential

development, especially north of Willett Pond into Westwood and along the southwest shore of the pond. There are over 200 residences in the drainage area.

b. Discharge. Normal discharge is over the spillway and into a stone-lined channel leading to Hawes Brook. The spillway is a three-bay concrete box culvert with an effective length of 24.9 feet. There are wooden stoplogs mounted just upstream of the culvert, and the top of the stoplogs is at El 139.0. This discharge channel is about 220 feet long and 20 to 24 feet wide and discharges into Hawes Brook downstream of the toe of the dam. The valley below the dam is a 400- to 500-foot wide swamp, heavily overgrown with brush and trees. Pools and streams of water are present at several locations below the dam, so that the bed of Hawes Brook is not clearly defined until farther downstream.

Discharge also occurs from the two 20-inch outlet pipes which discharge into a Parshall flume and then into the swamp. This discharge is controlled by gate valves which are opened in the late summer and fall for flood control.

Hydraulic analyses indicate that the spillway without stoplogs can discharge an estimated 750 cfs with the pond at El 142.1, which is the average low point on the crest of the dike. The test flood outflow (full PMF) is estimated to be 4,380 cfs with the pond at El 143.6. During the test flood, the main dam would not be overtopped, but the dike would be overtopped by a maximum of 1.5 feet. The pond could also flow out through a low area just south of the south abutment of the main dam and discharge down Bullard Street. The low area is about 10 to 30 feet wide and about 1.5 feet below the crest of the main dam. The spillway without stoplogs can discharge 17 percent of the test flood before the dike is overtopped. With the stoplogs in place, the spillway can discharge 440 cfs or 10 percent of the test flood before the dike is overtopped.

Flood levels at the gaging station located downstream on the Neponset River have been recorded since October 1939. The maximum discharge recorded on August 19, 1955 was 1,490 cfs for the 35.2 square mile watershed including Willett Pond. The dam at Willett Pond was reportedly not overtopped or damaged in this storm.

c. Elevation (feet above Mean Sea Level (MSL)). A benchmark was established at El 139.0 on top of the stoplogs at the spillway. This elevation was estimated from a United States Geological Survey (USGS) topographic map.

(1) Top dam - Main dam: 143.7 to 144.6
Dike section: 142.0 to 142.8

(2) Test flood pool: 143.5

(3) Design surcharge (original design): Unknown

(4) Full flood control pool: Not Applicable (N/A)

(5) Recreation pool: 139.0 top of stoplogs

(6) Spillway crest (without stoplogs): 137.7

(7) Upstream portal invert diversion tunnel: N/A

(8) Streambed at centerline of dam: 118.7

(9) Tailwater: 119.0 - swamp below dam

d. Reservoir

(1) Length of maximum pool: 6,000 feet

(2) Length of recreation pool: 6,000 feet

(3) Length of flood control pool: N/A

e. Storage (acre-feet)

(1) Test flood surcharge (net): 1,227 at El 143.6

(2) Top of dam (El 142.1, average low point on dike): 2,785

(3) Flood control pool: N/A

(4) Recreation pool (El 139.0, top of stoplogs): 2,140

(5) Spillway crest (El 137.7): 1,870

f. Reservoir Surface (acres)

*(1) Top dam: 208

*(2) Test flood pool: 208

(3) Flood control pool: N/A

(4) Recreation pool: 208

(5) Spillway crest (without stoplogs): 208

g. Dam

(1) Type - Main dam: earthfill embankment, concrete core wall, asphalt pavement on crest
- Dike section: earthfill embankment, concrete core wall

(2) Length - Main dam: 900 feet
- Dike section: 1,900 feet

(3) Height - Main dam: (maximum) 25 feet
- Dike section: (maximum) 14 feet

(4) Top width - Main dam: 23 to 27 feet
- Dike section: 13 to 16 feet

(5) Side slopes - Main dam: downstream 2:1 to 2.5:1; upstream 2:1
- Dike section: downstream 2.4:1; upstream 2:1

*Based on the assumption that the surface area will not significantly increase with changes in pond elevation from 137.7 to 142.1.

(6) Zoning (dam and dike): Concrete core wall with embankment of pervious fill

(7) Impervious core (dam and dike): Concrete core wall

(8) Cutoff (dam and dike): Concrete core wall extends 4 to 10 feet below embankment to bedrock or impervious material.

(9) Grout curtain: None

h. Spillway

(1) Type: Broad-crested three-bay concrete box culvert with stoplogs mounted at upstream end

(2) Crest length: 24.9 feet

(3) Crest elevation: 137.7 (without stoplogs)
139.0 (top of stoplogs)

(4) Gates: None

(5) Upstream channel: Vertical concrete side walls extending 11 feet upstream, floor covered with sand and boulders

(6) Downstream channel: 20 to 24 feet wide, 220 feet long; vertical, concrete side walls extending 40 feet downstream, then earth sides lined with stone and concrete; floor is lined with stone and concrete

i. Regulating Outlets. The regulating outlet at the dam consists of two 20-inch diameter, cast- iron conduits extending from the upstream toe of the dam to the downstream toe. The invert of the conduits at the downstream toe is at El 118.7. Flow is controlled by gate valves in a gatehouse on the downstream slope. The gates are operated several times a year. Discharge is into a Parshall flume for measuring flow, and then into the swamp downstream.

SECTION 2

ENGINEERING DATA

2.1 General. Several drawings, specifications and previous inspection records are available for the Willett Pond Dam. A drawing, showing generalized sections through the dam and dike (see Figure B-5) and a 10-page specification, both prepared in 1911 by Lucian A. Taylor, were obtained from the Massachusetts Department of Public Works. A drawing dated 1913 showing a plan and section of the main dam (see Figure B-4) was obtained from the Town Engineer's Office in Norwood. A drawing dated 1952 showing a plan of the dike and property abutting the southern half of the pond was obtained from Bird & Sons, Inc. Four sheets of drawings dated 1971 for construction of the Parshall flume (see Figures B-6 and B-7) were prepared by Metcalf & Eddy, Inc. Previous inspection notes and an inspection report dated July 13, 1973 (see pages B-8 through B-13) were also obtained from the Massachusetts Department of Public Works. No other plans, specifications, or computations are available from the Owner, County, or State agencies relative to the design, construction or repair of this dam.

We acknowledge the assistance and cooperation of personnel from the Massachusetts Division of Waterways, the Massachusetts Department of Public Works, and the Norwood Town Engineer's Office; Mr. Malcolm White, representing the Neponset Reservoir Corporation; and Messrs. Jim Moylon and John Hays of Bird & Son, Inc.

2.2 Construction Records. The only construction records are the drawings referred to in Section 2.1 and included in Appendix B. There are no as-built drawings for the dam, dike or appurtenant structures.

2.3 Operating Records. No operating records are available, and there is no daily record kept of the elevation of the pool or rainfall at the dam site.

2.4 Evaluation

a. Availability. There is limited engineering data available.

b. Adequacy. The lack of detailed structural and construction data did not allow for a definitive review. Therefore, the evaluation of the adequacy of this dam is based on review of available drawings and specifications, review of past inspection reports, visual inspection, past performance history, and engineering judgment.

c. Validity. Comparison of the available drawings with the field survey conducted during the Phase I inspection indicates that the available information is valid. There were minor discrepancies between the 1911 and 1913 drawings concerning the height and top elevation of the core wall in the main dam. This could not be checked in the field.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The Phase I Inspection of the dam at Willett Pond was performed on December 5, 1978. The inspection of the dike was conducted on December 12, 1978. A reinspection of the dam and dike was done on March 21, 1979. A copy of the inspection checklist is in Appendix A. Previous inspections were conducted by Norfolk County in August, 1945, September, 1945, and May, 1968. An inspection report prepared by the Massachusetts Department of Public Works in July, 1973 is given in Appendix B (see pages B-8 through B-13).

b. Dam. The dam consists of a 900-foot long, 25-foot high earth embankment, with a spillway at the south abutment and with an outlet and gatehouse located about 270 feet north of the south abutment. Also impounding the pond is an earth dike about 1,900 feet long and 13 feet high located just south of the main dam.

The main dam is in fair condition. The area near the downstream toe is wet and soft. Several locations of seepage were observed along the toe from the spillway to the fill area north of the gatehouse. In March, 1979, two streams of seepage were also flowing from the base of the fill area, as shown on Figure B-1. A rectangular, stone-lined hole is located just downstream of the fill, and may be an abandoned outlet. A stream of orange water is flowing from this opening southward into Hawes Brook. Much of the area below the dam is a swamp which extends downstream and appears to be a natural feature. The toe of the embankment may have been constructed on or adjacent to organic material, however, the core wall probably extends below the swamp level.

The most obvious deficiency at the main dam is the severe erosion of the upper portion of the upstream face near the crest. This erosion has undermined portions of the roadway, caused

tilting of the fence along the edge of the road and washing of soil down over the riprap. Other than wave action, this erosion is probably due to surface runoff from the road, which has no curb or drainage system. The surface of the road is cracked, irregular, and patched in places. The riprap on the upstream slope of the dam is mostly intact. A few pieces are missing, but there is no filling or chinking between the stones. Small trees and brush are growing along the entire length of the upper upstream slope.

The downstream slope of the dam contains a moderate growth of brush and small oak trees, except in the vicinity of the gatehouse. Surface runoff from the road has eroded gullies locally and one section of the fence along the downstream edge of the crest is tilted downstream.

The embankment of the dike is in fair condition. The upstream slope is covered with riprap, but footpaths and wave erosion have caused local sloughing. Birch trees are growing along most of the upstream edge of the crest. The downstream slope is covered by a moderate to thick growth of trees and brush. No seepage was observed along the dike.

c. Appurtenant Structures. The spillway for the main dam is a three-bay box culvert beneath the road on the crest. Although the concrete walls were recently resurfaced with gunite, cracking and erosion has occurred on the lower portion of the approach walls upstream of the spillway and on the invert of the box culvert (see photographs 7 and 8 in Appendix C). During a subsequent visit to the dam in March 1979, a tree stump and other dead wood were caught on the stoplogs of the spillway.

The outlet for the dam is two 20-inch diameter cast-iron pipes which discharge at the downstream toe into a Parshall flume. A gatehouse is located on the downstream slope and contains manually operated valves to control flow. The gatehouse is in good condition and kept locked. The outlet pipes in the foundation of the gatehouse are submerged in standing water. The

outlets were discharging at the time of inspection and could not be examined closely. The flume is in good condition, although some erosion and spalling has occurred on the inside of the concrete walls. Water is seeping out of the flume through a construction joint on the upstream wall, forming a pool of water outside the wall.

d. Reservoir Area. The area around Willett Pond contains sections of moderate and thick residential development. There are about 50 residences around the pond. It is possible that future development could occur, especially along the northwest portion of the shoreline. The land is about half wooded and about half cleared, with slopes ranging from 4 to 10 percent.

e. Downstream Channel. The discharge channel below the spillway is lined with stone and voids are filled in with concrete. Several large holes 1 to 3 feet deep have been eroded in the floor of the discharge channel (see photograph 11 in Appendix C). On both sides of the channel, trees are growing which could fall and partially block the channel during a flood. Near the downstream end of the channel, the north side has been eroded and, during the March 1979 visit, water was discharging through the side and flowing upstream toward the toe of the dam.

Water discharging from the Parshall flume flows into a swamp, although some water pools around the outside of the flume. Around and downstream of the flume, the area is flat, swampy and thickly wooded.

3.2 Evaluation. The above findings indicate that the dam is in fair condition and that there are several deficiencies which require attention. It is evident that the dam is not adequately maintained. Recommended measures to improve these conditions are stated in Section 7.3.

SECTION 4

OPERATING PROCEDURES

4.1 Procedures. Personnel from Bird & Son, Inc. reportedly visit the dam three to four times a week. Normal procedures at the dam consist of seasonally operating the outlets to maintain a downstream discharge and to provide storage for spring runoff. A minimum flow of 3 mgd is maintained as measured at a gaging station located about 2 miles downstream on the Neponset River. To accomplish this, personnel check the flow at the gaging station periodically during dry months. The outlets are opened as required, usually in July and August. The pond is also reportedly drawn down by 2 or 3 feet in the late fall.

4.2 Maintenance of Dam. Periodic maintenance of the dam has been conducted in the past. Trees and brush have been kept cleared from the downstream slope in the vicinity of the gatehouse. There is also evidence of past clearing of trees and brush in other areas on both the upstream and downstream slopes. However, subsequent growth has occurred. About two or three years ago, the concrete on the spillway and side walls of the downstream channel was repaired and resurfaced with gunite.

Present conditions at the dam indicate that it has not been adequately maintained. Seepage was observed at several locations along the downstream toe of the embankment. Erosion has occurred on the upstream edge of the dam, causing undermining of the road, loss of some riprap and tilting of the fence along the road. Trees and brush are growing on the upstream and downstream slopes of the dam. The gunite and concrete on the spillway is cracked and eroded below the level of the stoplogs. The floor and north side of the discharge channel are eroded, and trees are lining both sides of the channel. The dike contains localized erosion on the upstream face and growth of trees on the upstream and downstream slopes.

4.3 Maintenance of Operating Facilities. The outlet pipes are operated regularly. The control valves are located inside a building which is kept locked

and in good condition. The outlet pipes are submerged below standing water in the foundation of the gatehouse. There is some erosion and spalling of the inside walls of the flume located below the outlet pipes.

4.4 Description of Any Warning System in Effect. There is no warning system in effect at this dam.

4.5 Evaluation. Although maintenance personnel visit the dam regularly, the maintenance program is inadequate. There is no program of technical inspections or any warning system in effect at Willett Pond Dam. This is extremely undesirable considering the dam is in the "high" hazard category. A regular program of inspection and maintenance and a surveillance system for this dam should be implemented as recommended in Section 7.3.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. General. Willett Pond is impounded by a 900-foot long, 25-foot high earth dam and by a 1,900-foot long earth dike. The crest of the dike was found to be 1 to 2 feet below the crest of the main dam. The drainage area for the pond is 5.55 square miles and is located in suburban communities with sections of thick residential development. Bubbling Brook and Mill Brook drain into the pond. The valley below the dam is wide and swampy. A low, earth dam, which has been breached, is located 800 feet downstream. Ellis Pond Dam is located 3,700 feet downstream, and the pond is surrounded by housing.

The maximum storage in Willett Pond is calculated to be 2,785 acre-feet. The maximum flood level is unknown; there is no mention in the County records of the dam being overtopped. The pond has been used for industrial purposes in the past. It is now used to control flow in the Neponset River and for recreation.

b. Design Data. There are no hydraulic/hyrologic computations available for the design of the spillway at Willett Pond Dam.

c. Experience Data. Records for the gaging station downstream on the Neponset River indicate that the maximum flood discharge since 1886 was a rate of 1,490 cfs (42.3 cfs per square mile) on August 19, 1955. Personnel employed at the time at Hollingsworth & Vose Co. state that the dam was not overtopped or damaged in that storm.

It was noted that during the December 1978 inspection, the pond had been drawn down and, with a relatively dry fall, the level was at El 132.8. During a return visit in March 1979, water was flowing over the stoplogs of the spillway (El 139.0), indicating a seasonal fluctuation of over 6 feet for the pond.

d. Visual Observations. Water discharges over stoplogs at the upstream edge of the crest of the spillway. The spillway is a three-bay concrete box culvert with an invert at El 137.7 and an effective weir length of 24.9 feet. The discharge channel is 20 to 24 feet wide, 220 feet long and the floor slopes at 8 percent. The sides of the channel are vertical, concrete walls, 5.4 feet high at the spillway and tapering down to less than 1 foot high were they end about 40 feet downstream. Below this, the sides of the channel are 1 or 2 feet high and made of earth, lined with boulders and concrete. The floor is lined with boulders and concrete.

A tree stump and a few other pieces of dead wood were caught on the stoplogs of the spillway. Large holes 1 to 3 feet deep have been eroded in the floor of the discharge channel. Trees are growing along both sides of the channel and could fall down during a flood. The lower 20 feet of the north side of the channel has been eroded, allowing some water to discharge through the side and flow upstream toward the toe of the dam.

The outlet for the dam consists of two 20-inch conduits which discharge into a Parshall flume and then into the swamp below the dam. Flow is controlled by gate valves which are located in a gatehouse and are operated several times a year. The outlets were discharging at the time of inspection. Some water was pooled around the foundation of the flume.

A more detailed discussion of the condition of the dam and appurtenances is given in Section 3, Visual Inspection.

e. Test Flood Analysis. Willett Pond Dam has been placed in the "intermediate" size category and in the "high" hazard category. In accordance with the Corps of Engineers' guidelines, the full PMF was used to evaluate the capacity of the spillway.

The PMF rate for Willett Pond Dam was determined to be 1,000 cfs per square mile of drainage area. This calculation is based on

the average slope of the drainage area of 1.5 percent. The pond- plus-swamp area to drainage area ratio of 12 percent, and the U.S. Army Corps of Engineers' guide curves for Maximum Probable Flood Peak Rates (dated December 1977). Applying the full PMF rate to the 5.55 square miles of drainage area results in a calculated peak flood flow of 5,550 cfs as the test flood inflow. By adjusting the test flood inflow for surcharge storage, the maximum discharge rate was established as 4,380 cfs (790 cfs per square mile) with the level of the pond at El 143.6.

Hydraulic analyses indicate that the spillway (without stoplogs) can discharge a maximum of 740 cfs with the pond at El 142.1, which is the average low point on the crest of the dike. This discharge is 17 percent of the test flood outflow. During the test flood, the main dam would not be overtopped, but the dike would be overtopped by a maximum of 1.5 feet. The pond could also flow out through a low area just south of the south abutment of the main dam and discharge down Bullard Street. The low area is about 10 to 30 feet wide and about 1.5 feet below the crest of the main dam. During the test flood, discharge over the crest of the dike is estimated to be 3,320 cfs with a maximum head of 1.5 feet. The depth at critical flow would be 0.91 feet with a velocity of 5.41 feet per second. With the stoplogs in place, the spillway can discharge 440 cfs or 10 percent of the test flood before overtopping the dike.

The two 20-inch outlet pipes can discharge a flow of 96 cfs when the level of the pond is at the crest of the spillway without stoplogs. Starting at that elevation, the outlets can lower the pond by 1 foot in about 25 hours.

f. Dam Failure Analysis. The peak discharge rate due to failure of the main dam was calculated to be 24,000 cfs, assuming a breach 154 feet wide and a head of 20 feet. Failure of the main dam would produce a flood wave obout 10.5 feet high about 1,500 feet downstream. This flood could result in excessive damage to residential and commercial property downstream of

both Willett Pond and Ellis Pond Dams. The failure could also cause loss of more than a few lives in residences between Willett Pond and Ellis Pond Dams.

The peak discharge rate due to failure of the dike along Bullard Street was calculated to be 4,600 cfs, assuming a breach 56 feet wide and a head of 13.4 feet. Failure of the dike would produce a flood wave about 3.5 feet high and 200 feet wide. Failure of the dike could result in excessive damage to residences along Bullard Street and cause the loss of a few lives.

For these reasons, the dam has been placed in the "high" hazard category.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The evaluation of the structural stability of the dam and dike at Willett Pond is based on a review of the available data, a review of previous inspection reports, and visual inspections conducted on December 5 and 12, 1978, and on March 21, 1979.

As discussed in Section 3, Visual Inspection, the dam and dike are in fair condition. Seepage was observed at several locations along the downstream toe of the dam. No seepage was observed at the toe of the dike. There were no visible signs of significant settlement of either structure. However, erosion of slopes and growth of trees and brush is occurring at both sites.

b. Design and Construction Data. The dam and dike were constructed in 1913. A specification dated 1911 by Lucian A. Taylor describes the methods and materials proposed for construction. Both embankments were to contain a core wall made of Portland cememt mixed with clean sand and gravel, less than 2-1/2 inches in diameter. The core wall at the main dam is 2 feet thick at the top, which is 1.5 feet above the crest of the spillway (about El 139). The drawing dated 1913, however, shows the top of the core wall at 3.5 feet above the "floor of the wasteway" (about El 141). The thickness of the core wall increases 1 foot for each 10 feet vertically to the level of the outlet pipes (20 feet on 1911 drawing, 17.5 feet on 1913 drawing). The core wall is then extended downward at the same thickness for 4 to 10 feet into bedrock or other "watertight" material. The core wall for the dike is constructed in a similar way, with its top 1 foot above the crest of the spillway (about El 139). The wall increases thickness to a height of 15 feet, and then is trenched into a "hard, water-tight" foundation with a thickness of 3 feet.

The embankments are described as being made from local sand and gravel, with no stones more than 6 inches in diameter and no vegetable matter. The embankments were to be laid in 8-inch layers and "thoroughly rolled" to prevent settlement. The specification calls for the ground beneath the embankments to be cleared, grubbed, and all vegetable matter and mud removed to a "firm" foundation, except beneath the lower half of the downstream slope. The area along most of the downstream toe of the dam is a swamp. The toe of the embankment may have been constructed on or adjacent to organic material, although the core wall probably extends below the swamp level.

c. Operating Records. There is no instrumentation of any type in the embankment at Willett Pond Dam, and no instrumentation was ever installed at this site. The performance of the embankment under prior loading can only be inferred by physical evidence at the site.

d. Post-Costruction Changes. During the period 1953 to 1970, several plans were proposed to divert water from Willett Pond and Hawes Brook to ponds near the Hollingsworth & Vose and Bird & Sons factories. None of these plans was ever implemented.

The Parshall flume below the spillway was constructed in 1971. Copies of the design drawings are shown in Appendix B. An instrument to record the discharge is located inside the gatehouse. About 1975, the concrete on the spillway was repaired and resurfaced with gunite.

e. Seismic Stability. The dam is located in Seismic Zone No. 2. Because of its configuration and the low head of water retained, a seismic analysis is not considered warranted.

SECTION 7

ASSESSMENT, RECOMMENDATIONS,
AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Based upon a review of available data, the visual inspection of the site, and limited operational or maintenance information, there are deficiencies which must be corrected to assure the continued performance of the dam. Seepage was observed at several locations along the downstream toe of the main dam. Several other signs of distress were also observed: wave erosion on the upstream slope of the dam causing undermining of the crest, erosion on the upstream and downstream slopes due to runoff from the road on the crest, trees and brush on the upstream and downstream slopes, cracking and spalling of gunite and concrete on the spillway, debris lodged on the stoplogs of the spillway, erosion of the floor and the north side of the spillway discharge channel, trees on the sides of the spillway discharge channel, and standing water around the outlet pipes in the gatehouse. The earth dike is eroded locally on the upstream slope and contains trees and brush on the upstream and downstream slopes.

Hydraulic analyses indicate that the spillway (without stoplogs) can discharge an estimated flow of 740 cfs with the pond at El 142.1, which is the average low point on the crest of the dike. An outflow test flood (full PMF) will not overtop the main dam, but will overtop the dike by a maximum of 1.5 feet. The pond could also flow out through a low area just south of the south abutment of the main dam and discharge down Bullard Street. The spillway can discharge 17 percent of the test flood before the dike is overtopped. With the stoplogs in place, the spillway can discharge 440 cfs or 10 percent of the test flood before the dike is overtopped.

b. Adequacy. The lack of detailed design and construction data did not allow for a definitive

review. Therefore, the evaluation of the adequacy of this dam is based on a review of the available data, the visual inspection, past performance and engineering judgment.

c. Urgency. The recommendations and remedial measures outlined below should be implemented by the Owner within one year after receipt of this Phase I Inspection Report.

7.2 Recommendations. In view of the concerns over the continued performance of the dam, it is recommended that the Owner employ a qualified consultant to: conduct a subsurface investigation to evaluate the seepage through the main dam, and conduct a more detailed hydraulic/hydrologic study to evaluate raising the dike, increasing existing spillway capacity and/or adding an emergency spillway.

Recommendations on repairs and maintenance procedures are outlined below under Section 7.3, Remedial Measures.

7.3 Remedial Measures

a. Operating and Maintenance Procedures. The dam and appurtenant structures are not adequately maintained. It is recommended that the Owner accomplish the following:

(1) immediately remove the stoplogs on the spillway and lower the pond by an arbitrary 2.7 feet (to El 135) below the crest of the spillway to reduce seepage pressure through the dam. The pond should be maintained at El 135 until the above recommendations and the following remedial measures have been completed.

(2) repair erosion on the upstream slopes of the dam and dike, replacing any missing riprap,

(3) construct a curb or drainage ditch along both sides of the roadway on the crest of the main dam to control surface drainage,

(4) initiate a program of selective clearing of trees and brush from both slopes of the main dam and dike, and from the sides of the spillway discharge channel,

(5) repair damaged gunite and concrete on walls and crest of spillway,

(6) repair erosion in the floor and in the north side of the spillway discharge channel,

(7) dewater the foundation of the gatehouse and determine the location and magnitude of the leakage,

(8) implement a systematic program of maintenance inspections. As a minimum, the inspection program should consist of a monthly inspection of the dam, dike and appurtenances, supplemented by additional inspections during and after severe storms. Maintenance should include clearing of debris from the spillway and discharge channel, clearing of trees and brush from the slopes, and repair of erosion to slopes or to the concrete on the spillway. All repairs and maintenance should be undertaken in accordance with all applicable State regulations.

(9) periodic technical inspections of this dam should be continued on an annual basis,

(10) institute a definite plan for surveillance and a warning system during periods of unusually heavy rains and/or runoff.

7.4 Alternatives. There are no recommended alternatives to implementing the recommendations and remedial measures listed above.

APPENDIX A

PERIODIC INSPECTION CHECKLIST

WILLETT POND DAM

PERIODIC INSPECTION

PARTY ORGANIZATION

PROJECT WILLETT POND DAM

DATE 5 DEC. 1978

TIME 8:30 AM

WEATHER Clear, Breezy

W.S. ELEV. 132.8* U.S. 119* DN.

*based on assumed benchmark at El.139.0 on top of stoplogs on spillway.

PARTY:

1. W. Checci
2. D. Cole
3. J. Komisarek
4. M. Larson
5. H. Lord
6. S. Pierce
7.
8.
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Dam Embankment	Larson/Komisarek	
2.	Spillway	Larson/Komisarek	
3.	Dike Embankment	Komisarek	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT WILLETT POND DAM DATE 5 DEC. 1978

PROJECT FEATURE Dam Embankment NAME Komisarek

DISCIPLINE Geotechnical NAME Larson

u/s=upstream
d/s=downstream
lt.=left
rt.=right

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	Varies from El. 143.7 to 144.6
Current Pool Elevation	132.8
Maximum Impoundment to Date	Unknown
Surface Cracks	Longitudinal cracks in road on crest
Pavement Condition	Alligator cracking, asphalt patches
Movement or Settlement of Crest	Settlement of road on both sides spillway
Lateral Movement	None visible
Vertical Alignment	Numerous small dips in road
Horizontal Alignment	Straight
Condition at Abutment and at Concrete Structures	Lt.abut.good-v.few trees, rolling ground;rt.abut.good-many trees,rock outcrop
Indications of Movement of Structural Items on Slopes	Fence on u/s edge of crest leaning u/s fence&telephone poles on d/s edge of crest leaning d/s
Trespassing on Slopes	Footpaths on d/s slope, rt. abut.
Sloughing or Erosion of Slopes or Abutments	u/s slope-consid.erosion&sloughing of road edge, also at one point on d/s edge.
Rock Slope Protection - Riprap Failures	u/s riprap full length,minor pieces dislodged,eroded near top of slope, slump at ctr of lt u/s slope,no fill material
Unusual Movement or Cracking at or near Toes	None visible
Unusual Embankment or Downstream Seepage	Seepage along toe from spillway channel to fill area north of gate house.
Piping or Boils	None
Foundation Drainage Features	None
Toe Drains	None visible
Instrumentation System	None

PERIODIC INSPECTION CHECK LIST

PROJECT WILLETT POND DAM DATE 12 DEC. 1978

PROJECT FEATURE Dike Embankment NAME Komisarek

DISCIPLINE Geotechnical NAME

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	
Crest Elevation	Varies from El.142.0 to 142.8
Current Pool Elevation	132.8
Maximum Impoundment to Date	Unknown
Surface Cracks	None visible
Pavement Condition	None
Movement or Settlement of Crest	Undulating with minor dips
Lateral Movement	None apparent
Vertical Alignment	Minor dipping
Horizontal Alignment	Follows curved shoreline
Condition at Abutment and at Concrete Structures	Good to fair-Joins natural knolls
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	Major footpaths,piers and landings, sandboxes, fireplaces
Sloughing or Erosion of Slopes or Abutments	None at abut., some on u/s slope at landings and paths
Rock Slope Protection - Riprap Failures	Good condition-some scattered sloughing
Unusual Movement or Cracking at or near Toes	None visible
Unusual Embankment or Downstream Seepage	None visible
Piping or Boils	None visible
Foundation Drainage Features	None
Toe Drains	None visible
Instrumentation System	None

PERIODIC INSPECTION CHECK LIST

PROJECT WILLETT POND DAM DATE 6 DEC. 1978

PROJECT FEATURE Spillway at Dam NAME Komisarek

DISCIPLINE Geotechnical NAME Larson

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	Concrete side walls, floor covered with sand, gravel, boulders
a. Approach Channel	
General Condition	Fair to good-cracking & erosion of lower portion of side walls
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Some trees & brush
Floor of Approach Channel	Sandy with boulders, spit island on u/s. side
b. Weir and Training Walls	Triple box culvert
General Condition of Concrete	Recent gunite application, severe spalling & erosion below water line, numerous cracks
Rust or Staining	Some staining
Spalling	Severe below water line, especially on invert
Any Visible Reinforcing	None
Any Seepage or Efflorescence	Minor seepage, extensive efflorescence
Drain Holes	None
c. Discharge Channel	Rock rubble with concrete matrix
General Condition	Very poor-several extensive holes due to scour, breach in left side
Loose Rock Overhanging Channel	Loose boulders rt.side, some natural rock outcrop in floor
Trees Overhanging Channel	Large trees and brush each side
Floor of Channel	Badly deteriorated, severe pitting, erosion, and scour
Other Obstructions	Channel discharges into swamp area

PERIODIC INSPECTION CHECK LIST

PROJECT WILLETT POND DAM DATE 5 DEC. 1978

PROJECT FEATURE Control Tower NAME Komisarek

DISCIPLINE Geotechnical NAME Larson

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	Brick building with concrete foundation, windows bricked on d/s. side, locked door.
a. Concrete and Structural	
General Condition	Good, vine-covered side
Condition of Joints	Good
Spalling	Minor amount,some due to vines
Visible Reinforcing	None
Rusting or Staining of Concrete	Algae stained concrete
Any Seepage or Efflorescence	None
Joint Alignment	Not applicable
Unusual Seepage or Leaks in Gate	None visible-outlet pipes submerged beneath standing water
Cracks	None visible
Rusting or Corrosion of Steel	Steel door sheathing rusted
b. Mechanical and Electrical	Two gate valves, hand operated, partially submerged in standing water
Air Vents	None
Float Wells	None
Crane Hoist	None
Elevator	None
Hydraulic System	None
Service Gates	None-two gate valves, one closed, one partially open
Emergency Gates	None
Lightning Protection System	None
Emergency Power System	None
Wiring and Lighting System in Gate Chamber	No lighting,chart recorder present to measure&record flow through flume

PERIODIC INSPECTION CHECK LIST

PROJECT WILLETT POND DAM DATE 5 DEC. 1978

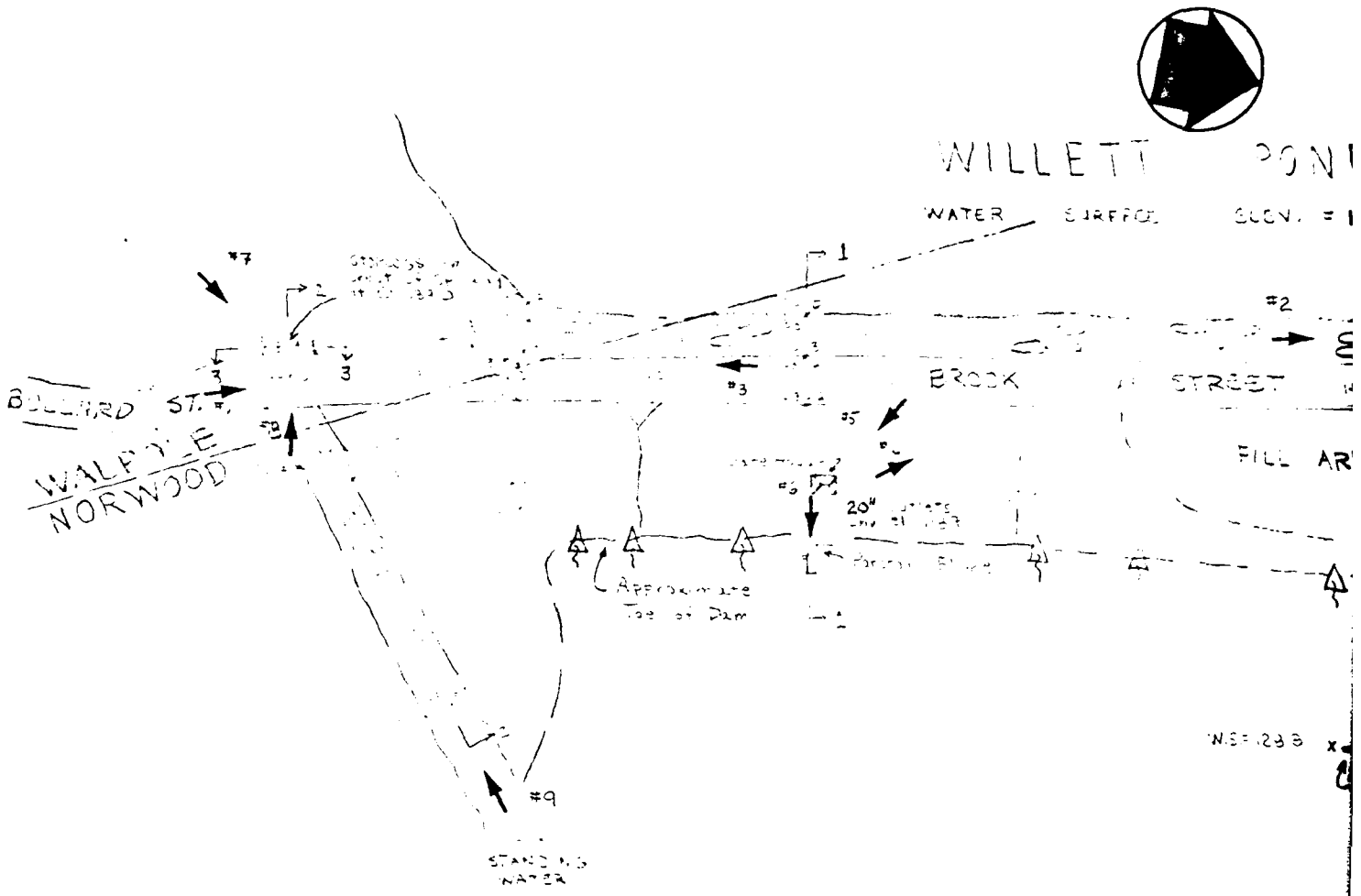
PROJECT FEATURE Discharge Flume NAME Komisarek

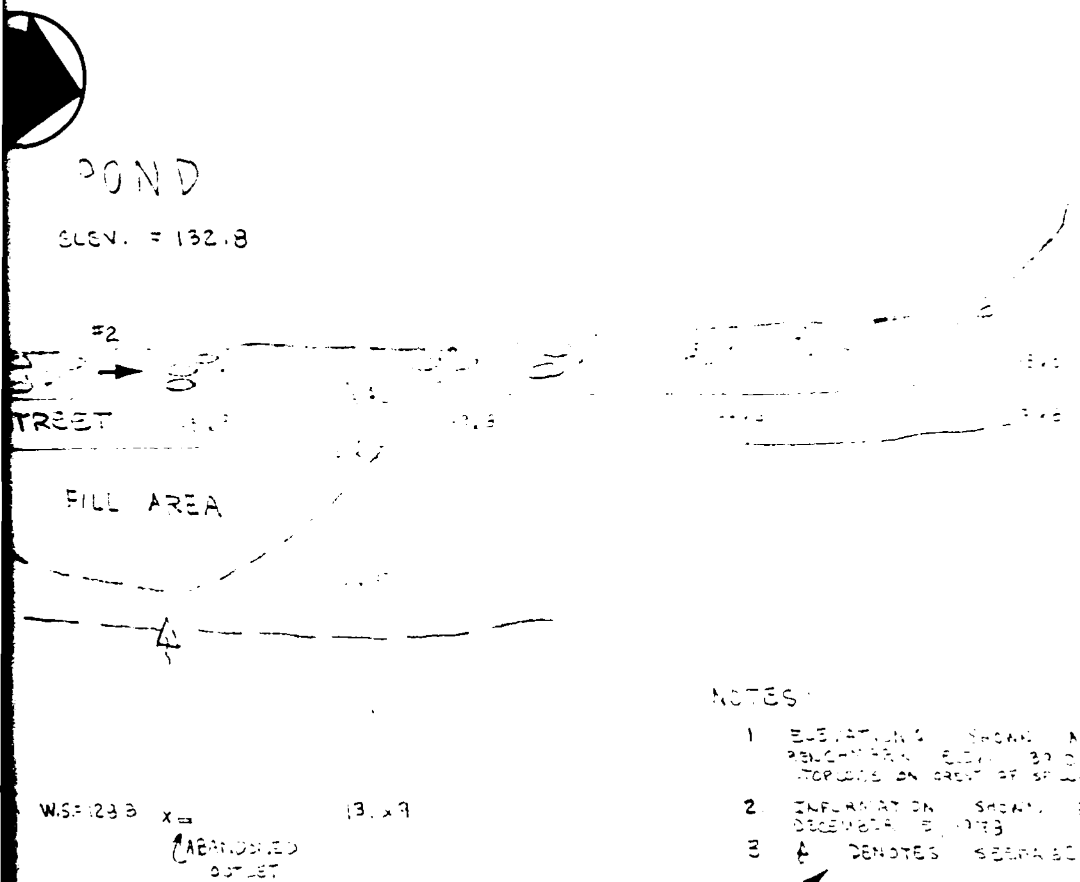
DISCIPLINE Geotechnical NAME Larson

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL General Condition of Concrete	Parshall-flume-combined poured concrete & cinder blocks. Fair to good, some spall on inside
Rust or Staining	Minor
Spalling	Minor spalling above water line-interior walls.
Erosion or Cavitation	Noted on cinder blocks and concrete-interior walls
Visible Reinforcing	None
Any Seepage or Efflorescence	Minor efflorescence on cinder block mortar
Condition at Joints	Minor at concrete cinder block joint
Drain Holes	None
Channel	Natural, boulders visible with misc. trash
Loose Rock or Trees Overhanging Channel	Trees and brush in and at channel edge
Condition of Discharge Channel	Poor to fair-natural, with minor trash present

APPENDIX B

PLANS OF DAM AND PREVIOUS
INSPECTION REPORTS


WILLETT
WATER
#7
#1
#2
#3
#5
#6
#9
BROOK
STREET
FILL AR
20"
Approximate
Toe of Dam
STANDING
WATER
WALPOLE
NORWOOD



NOTES:

1. ELEVATIONS SHOWN ARE [illegible] TO [illegible] BENCHMARK ELEV. [illegible] (MSL) [illegible] STOPLOGS ON CREST OF SPILLWAY.
2. INFORMATION SHOWN BASED ON FIELD [illegible] OF DECEMBER [illegible]
3. ℄ DENOTES SEEPAGE
4. ↗ [illegible] LOCATION AND DIRECTION OF VIEW FOR PHOTOGRAPHS
5. SEE FIGURE B-2 FOR SECTION THROUGH DAM
6. SEE FIGURE B-3 FOR DIKE AND SECTIONS THROUGH DIKE

METCALF & EDDY, INC. ENGINEERS BOSTON, MA	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA

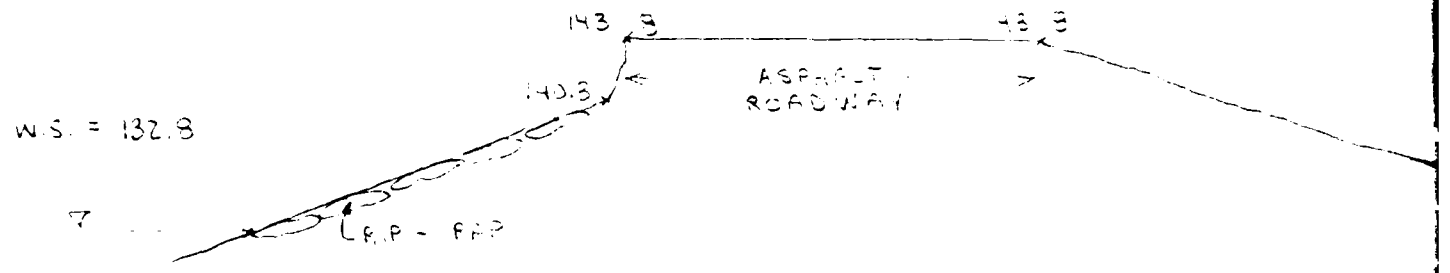
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

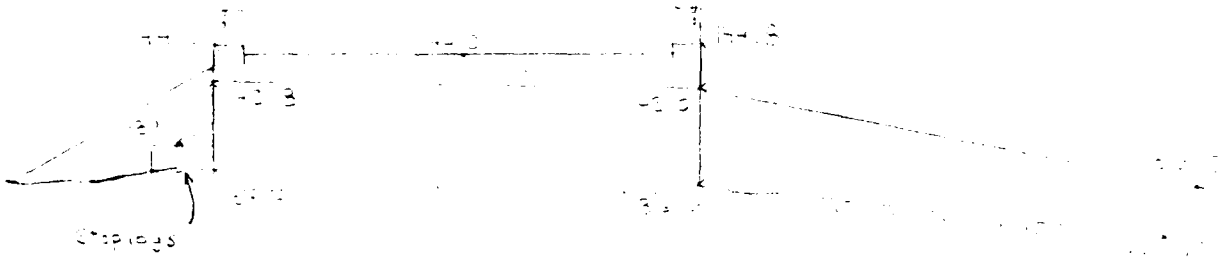
WILLETT POND DAM

FIGURE B-1 PLAN OF DAM

TRIBUTARY NEPONSET RIVER — MASSACHUSETTS

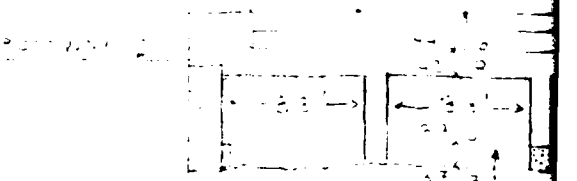
SCALE: AS SHOWN — DATE: MARCH, 1979



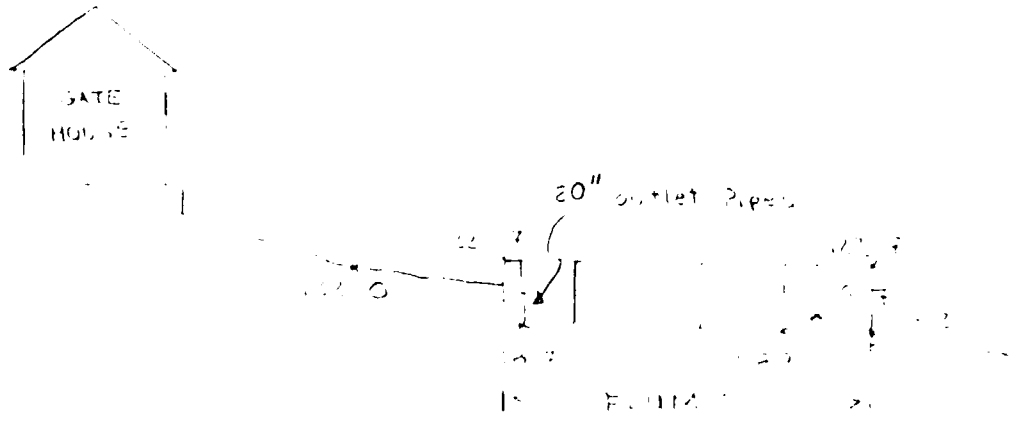


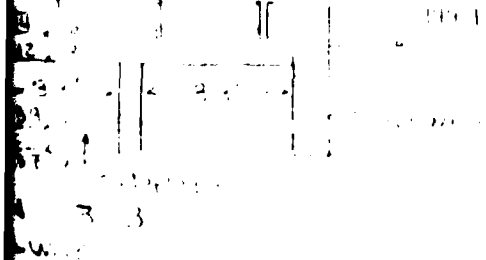
NOTES:

1. ELEVATIONS SHOWN ARE REFERENCED TO ASSUMED DATUM. ELEV. = 132.0 (MSL) AT TOP OF STOPLOGS ON CREST OF SPILLWAY.
2. INFORMATION SHOWN BASED ON FIELD SURVEY OF DECEMBER 5, 1973.
3. SEE FIGURE B-1 FOR LOCATIONS OF SECTIONS.



SECTION B-
SPILLWAY





METCALF & EDDY, INC.
ENGINEERS
BOSTON, MASS.

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MA

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

WILLETT POND DAM

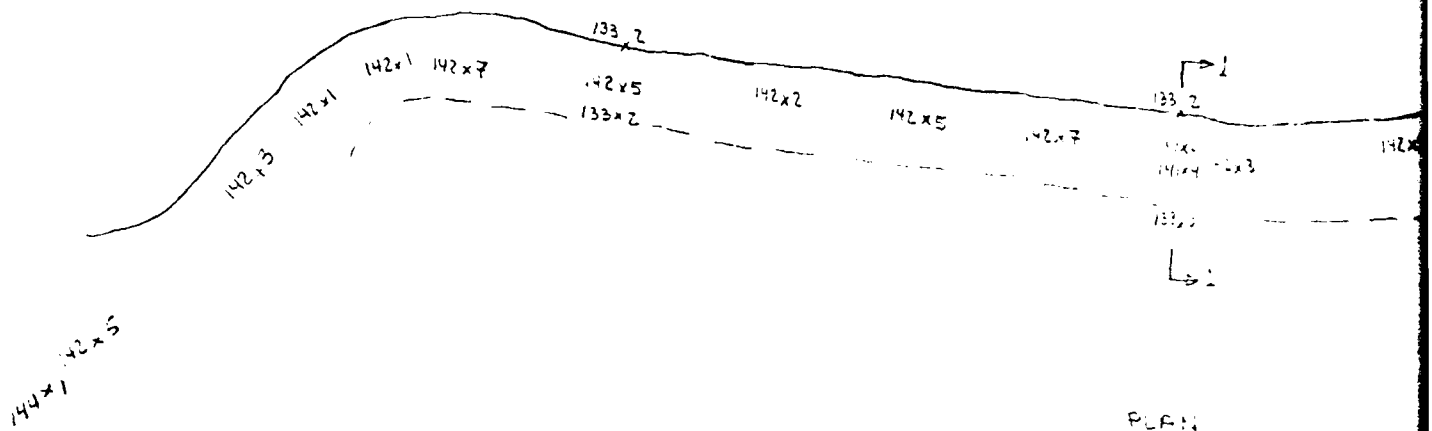
FIGURE B-2 SECTIONS THROUGH DAM

TRIBUTARY NEPONSET RIVER — MASSACHUSETTS

SCALE: 1" = 10' | DATE: MARCH, 1979

WILLETT P

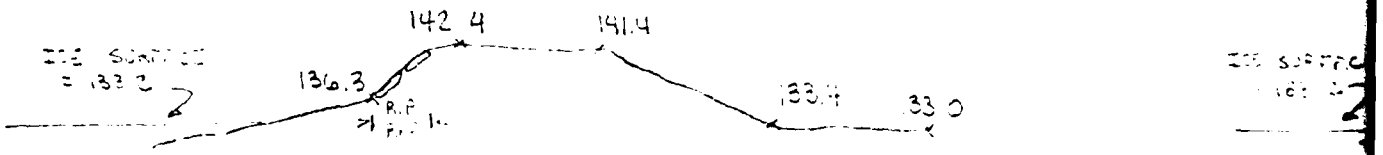
ICE SURFACE ELEV.



PLAN

SCALE 1/8 FEET

0 20 2-0



SECTION 1-1

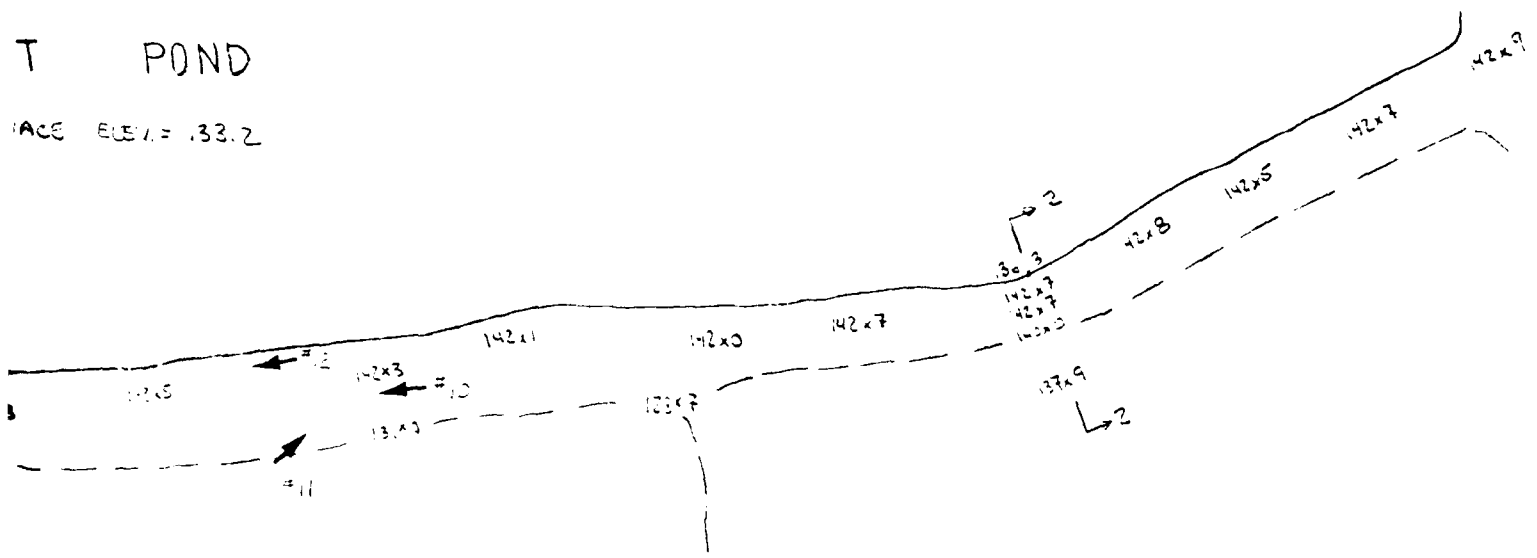
SECTION

SCALE 1/8 FEET

METCALF & EDDY, INC.

T POND

ACE ELEV. = 133.2

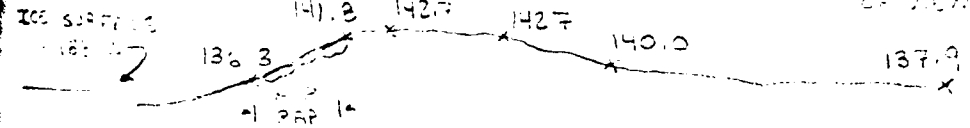


T

360

NOTE :

1. ELEVATIONS SHOWN ARE REFERENCED TO ASSUMED BENCHMARK ELEV. 137.9 (MSL) AT TOP OF STOPLOGS ON CREST OF SPILLWAY.
2. INFORMATION SHOWN BASED ON FIELD SURVEY OF DECEMBER 12, 1978.
3. ↗ = D IN DATA LOCATION SEE DIKE OF VIEW FOR ADDITIONAL



SECTION 2-2

METCALF & EDDY, INC. ENGINEERS BOSTON, MA.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM MA

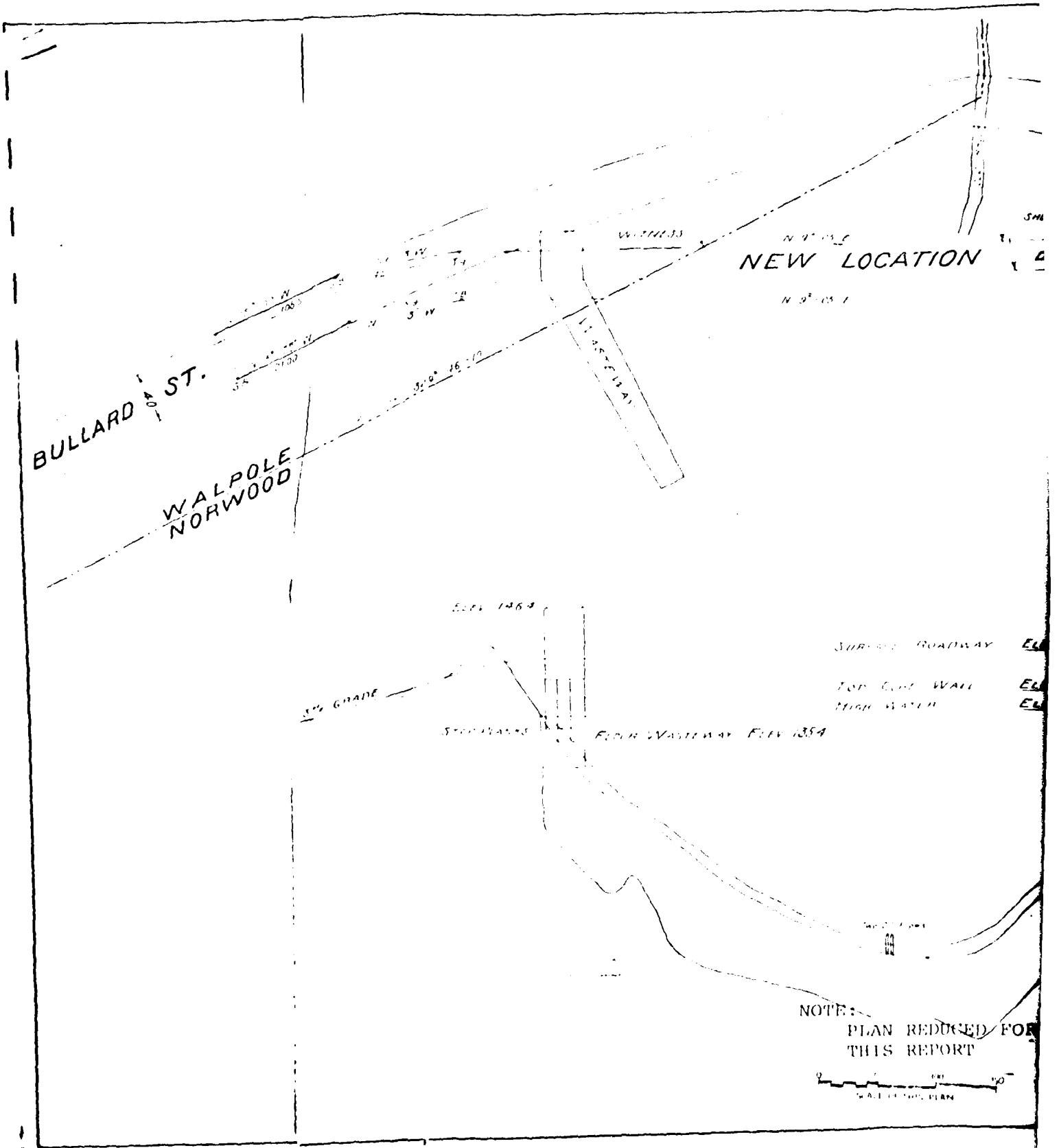
NATIONAL PROGRAM OF INSPECTION OF NON FED. DAMS

WILLETT POND DAM

FIGURE B-3 PLAN OF DIKE AND SECTIONS THROUGH DIKE

TRIBUTARY NEPONSET RIVER — MASSACHUSETTS

SCALE: AS SHOWN | DATE: MARCH, 1979


NEW LOCATION
BULLARD ST.
WALPOLE
NORWOOD
NOTE:
PLAN REDUCED FOR
THIS REPORT

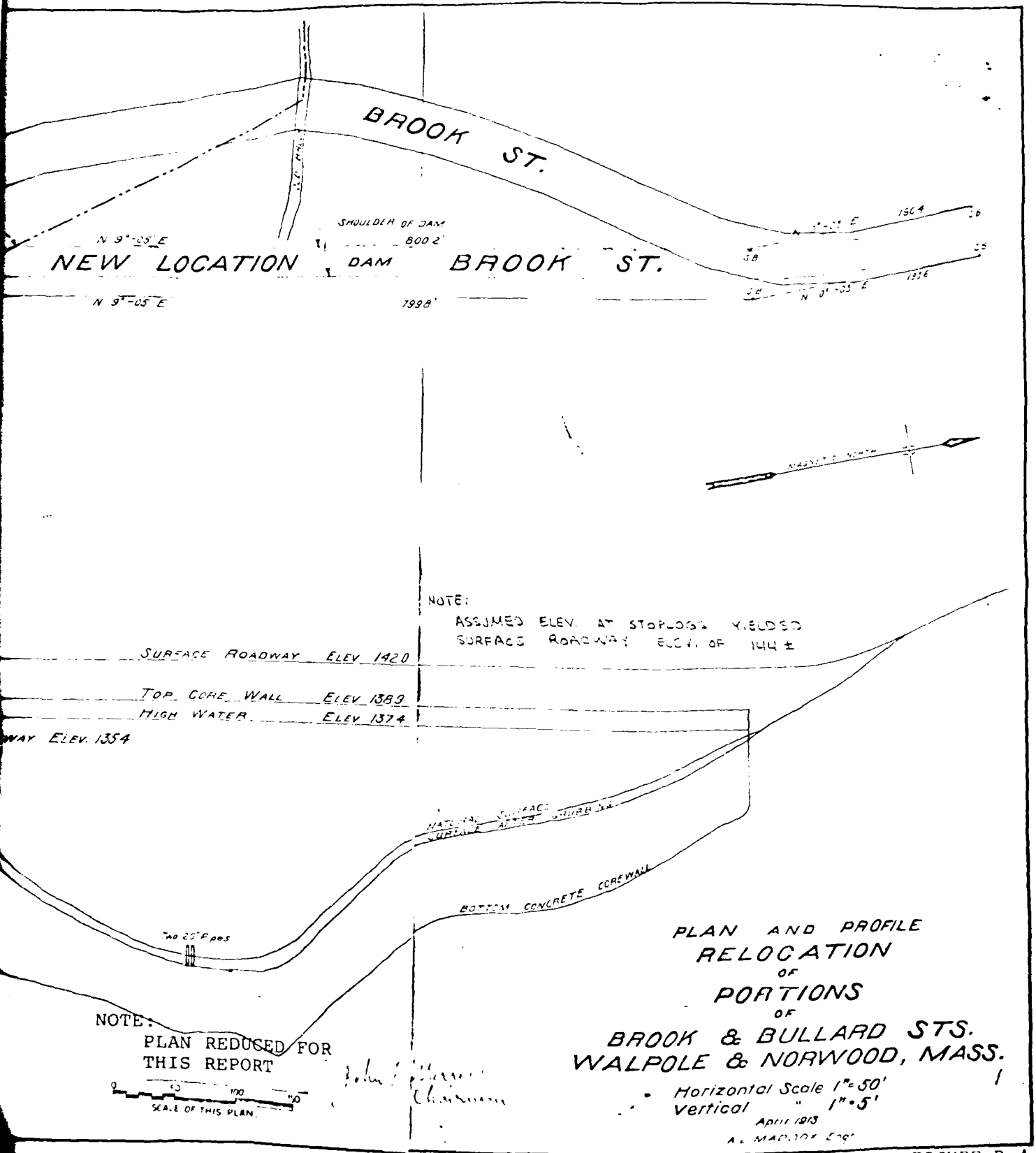
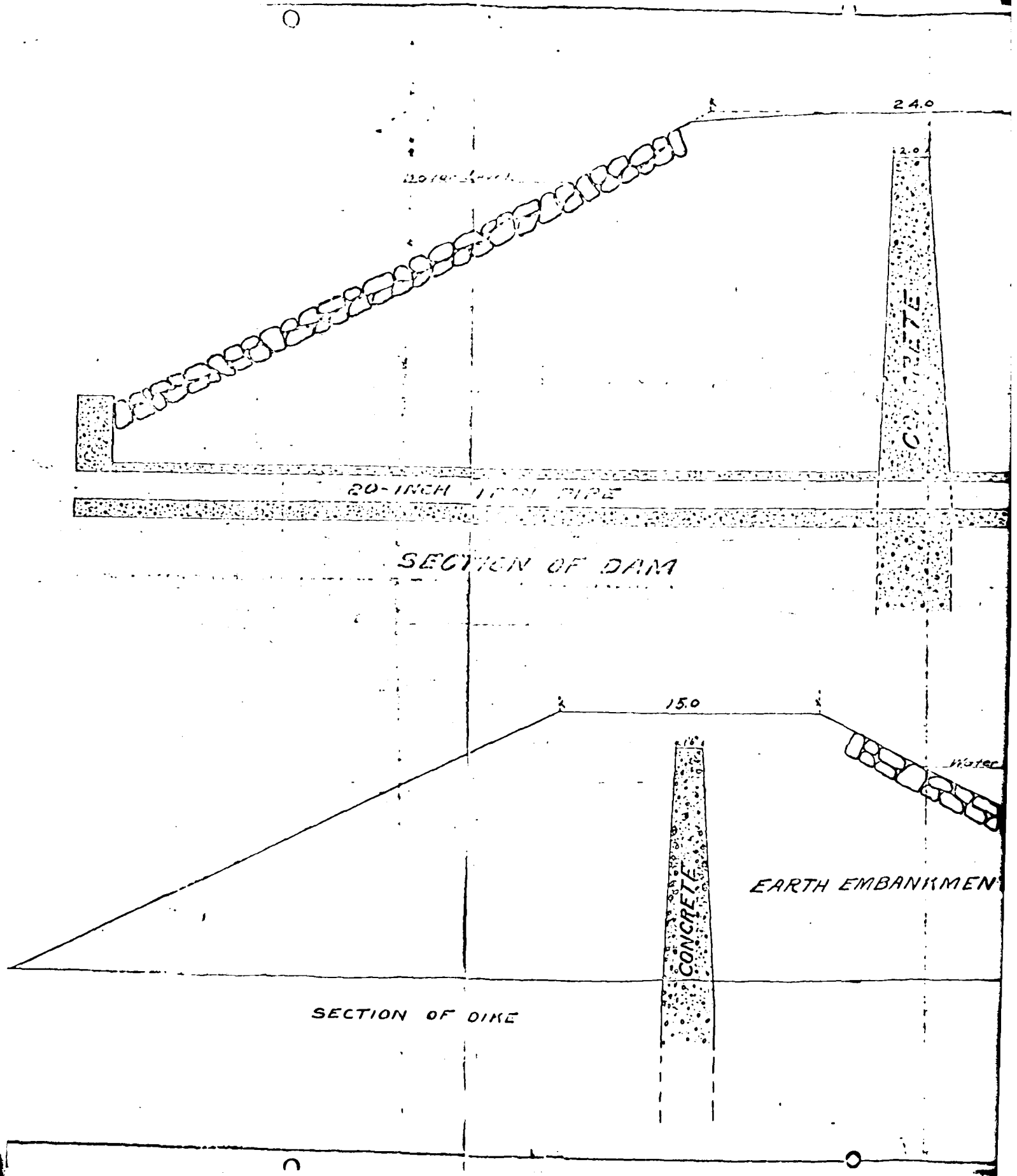
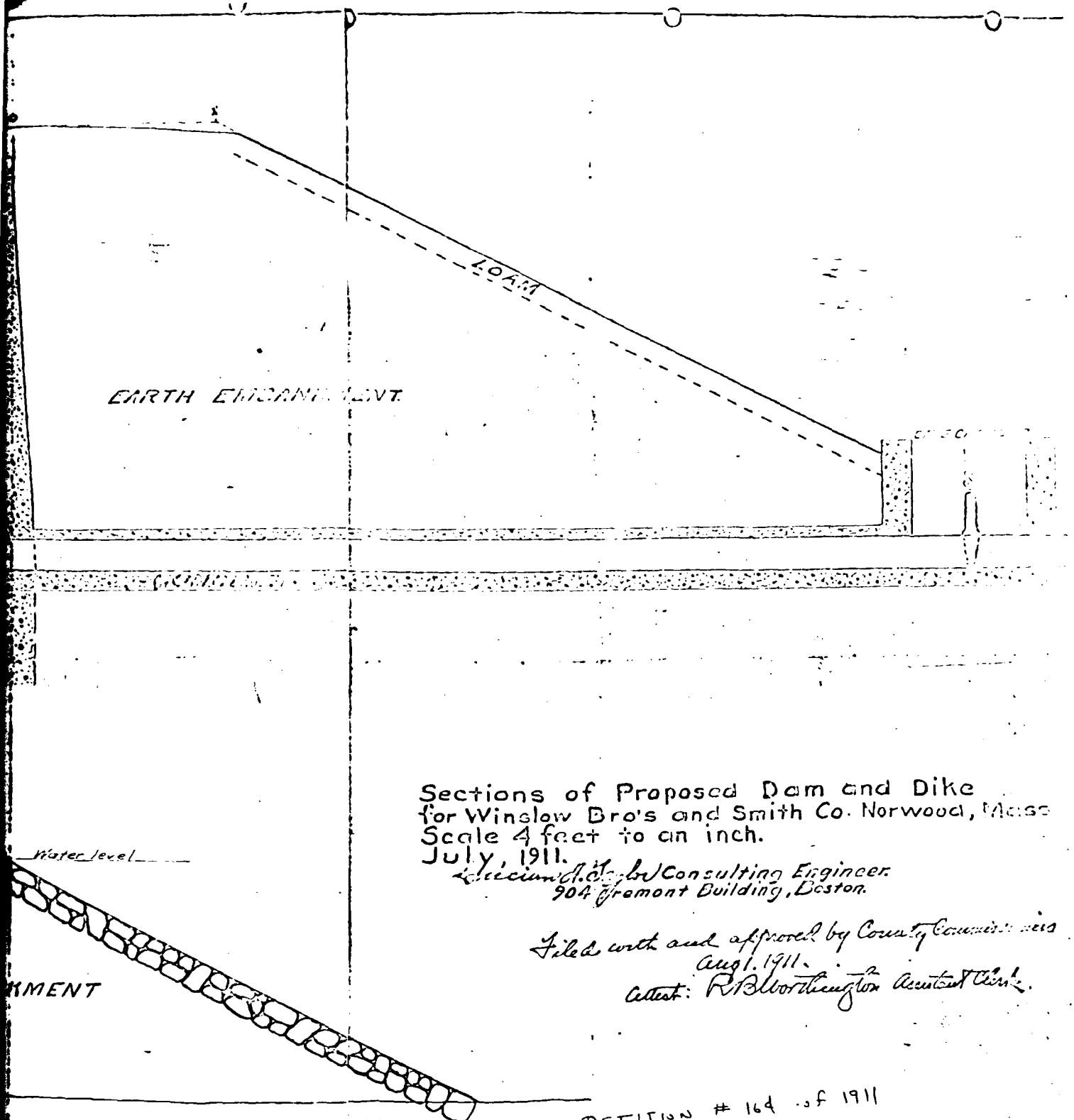


FIGURE B-4

WILLETT POND DAM


24.0
2.0
CONCRETE
20-INCH IRON PIPE
SECTION OF DAM
15.0
CONCRETE
EARTH EMBANKMENT
SECTION OF DIKE



Sections of Proposed Dam and Dike
for Winslow Bro's and Smith Co. Norwood, Mass
Scale 4 feet to an inch.
July, 1911.
Lincoln A. Taylor Consulting Engineer.
904 Tremont Building, Boston.

Filed with and approved by County Commissioners
Aug. 1911.
Attest: R Bloorthington Assistant Clerk.

PETITION # 164 of 1911
COUNTY COMMISSIONERS REC.

NOTE:
PLAN REDUCED FOR
THIS REPORT

WILLETT POND DAM

FIGURE B-5

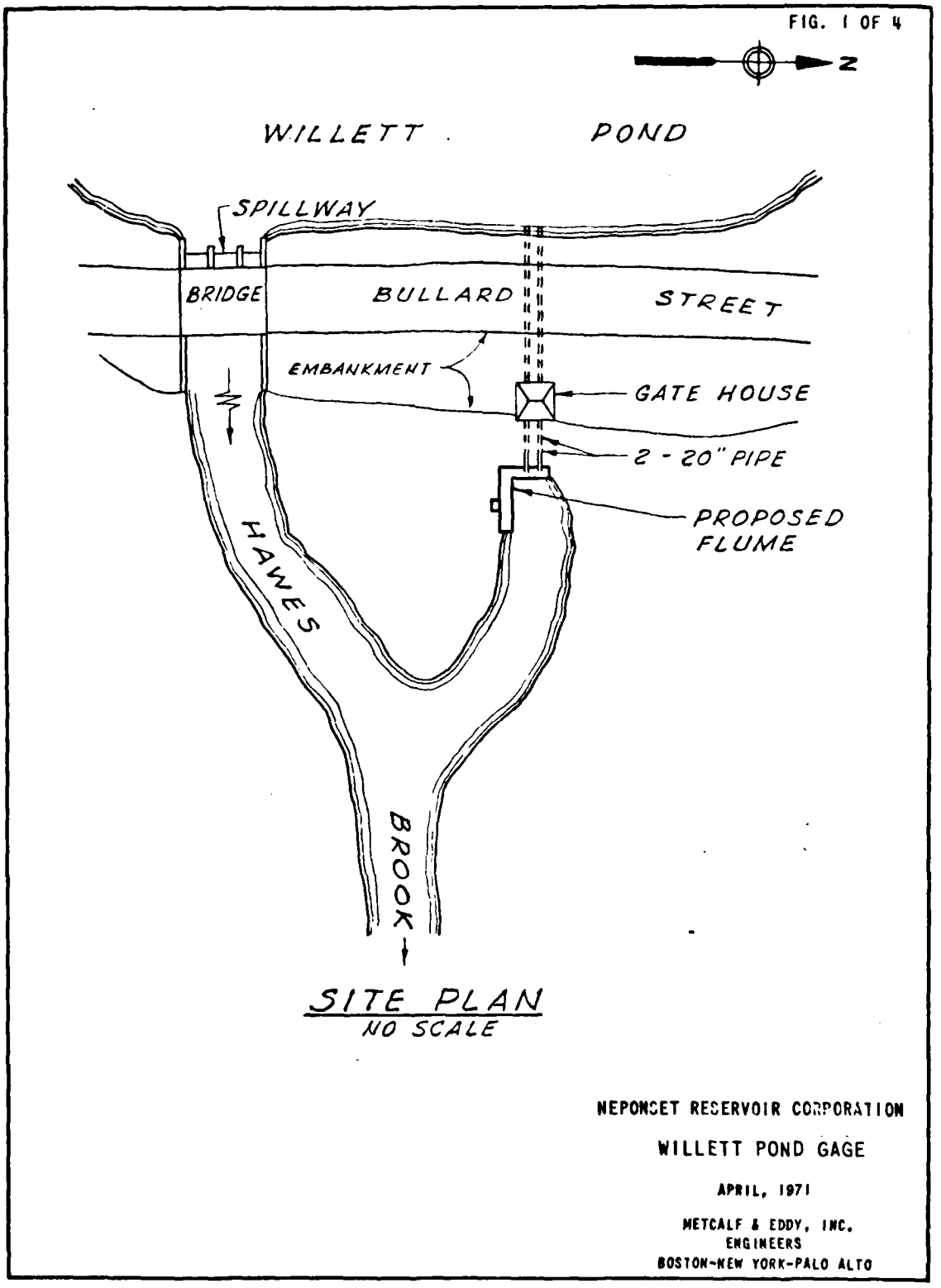
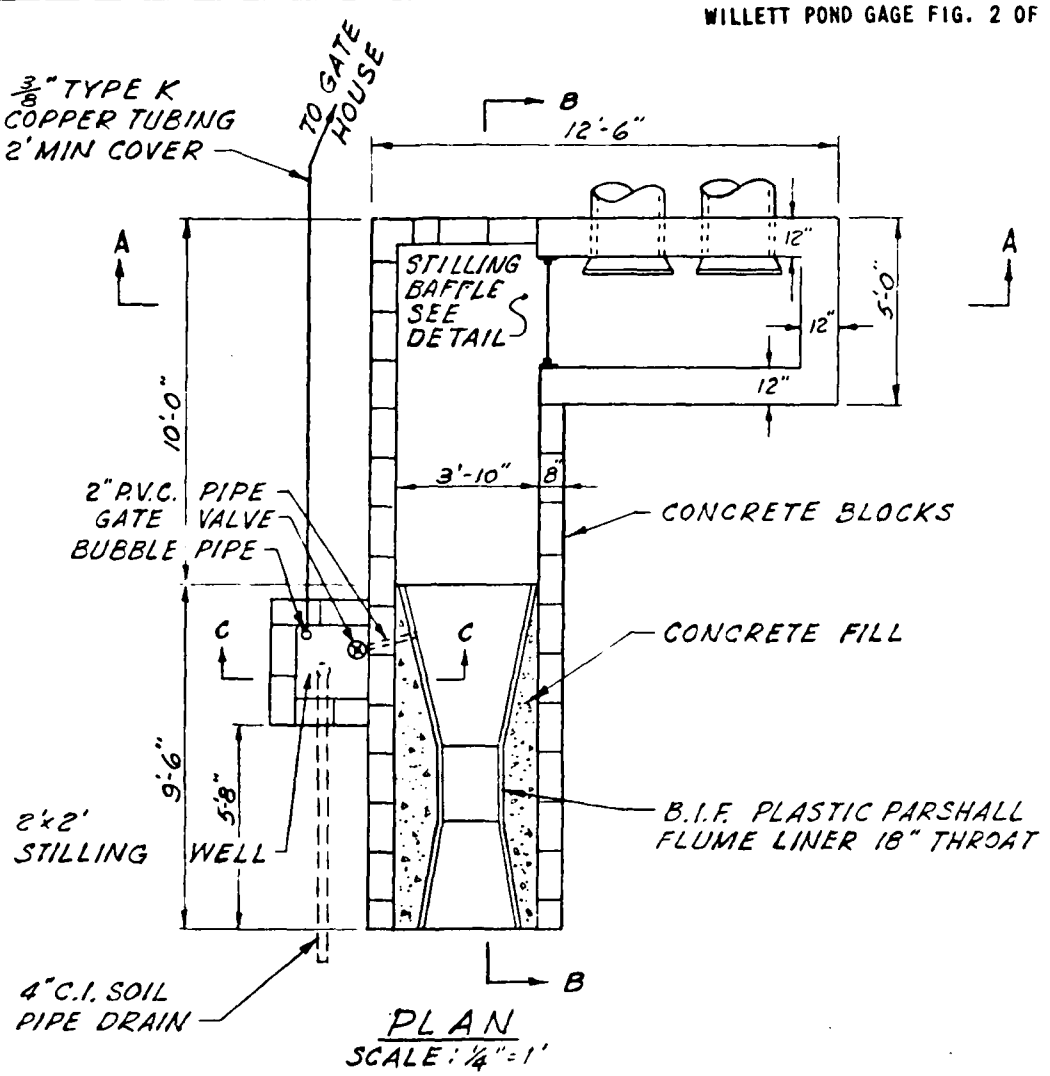


FIG. 1 OF 4
Z-25315-1
N
WILLETT POND
SPILLWAY
BRIDGE
BULLARD STREET
EMBANKMENT
GATE HOUSE
2 - 20" PIPE
PROPOSED FLUME
HAWES BROOK
SITE PLAN
NO SCALE
NEPONSET RESERVOIR CORPORATION
WILLETT POND GAGE
APRIL, 1971
METCALF & EDDY, INC.
ENGINEERS
BOSTON-NEW YORK-PALO ALTO

Z-25516-1



PLAN
SCALE: 1/4" = 1'

NOTE:
AIR SUPPLY, RECORDER AND AIR CONTROL VALVES TO BE LOCATED IN EXISTING GATE HOUSE.
SAME EQUIPMENT AND ARRANGEMENT AS AT NEPONSET RESERVOIR GAGE.

INSPECTION REPORT - DAMS AND RESERVOIRS

1. Location: ~~City~~/Town Norwood. Dam No. 6-11-220-2
Name of Dam Willett Pond INSPECTED BY: A.H. Lounsbury
Date of Inspection July 13, 1973.

2. Owner/s: Per: Assessors ✓. Prev Inspection ____.
Reg. of Deeds ____. Pers. Contract ____.

	Name	St. & No.	City/Town	State	Tel No.
1.	Neponset Reservoir Corp.	c/o Bird & Son	East Walpole	Mass.	
2.					
3.					

3. Caretaker(if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Name	St. & No.	City/Town	State	Tel. No.

4. No. of pictures taken ____.

5. Degree of Hazard: (If dam should fail completely)*
1. Minor ____. 2. Moderate ✓.
3. Severe ____. 4. Disastrous ____.
*This rating may change as land use changes (Future development)

6. Outlet Control: Automatic ____. Manual ✓.
Operative UNC. yes ; ____ No.
Comments: ____

7. Upstream Face of Dam: Condition*
1. Good ____. 2. Minor Repairs ✓.
3. Major Repairs ____. 4. Urgent Repairs ____.
Comments: Remove Tree Growth
Grout Rip Rap

DAI NO. 6-11-220-2

Downstream Face of Dam: Condition: 1. Good_____. 2. Minor Repairs ✓.
3. Major Repairs_____. 4. Urgent Repairs_____.

Comments: Tree growth
Considerable poison ivy growth on slope (downstream)
prevents close inspection. Appears fair to good

9. Emergency Spillway: Condition: 1. Good ✓. 2. Minor Repairs_____.
3. Major Repairs_____. 4. Urgent Repairs_____.

Comments:_____

10. Water level @ time of inspection: 0.10 ft. above ✓. below_____.
top of dam_____. principal spillway ✓.
other_____.

11. Summary of Deficiencies Noted:

Growth (trees and bruch) on Embankment Considerable 2" to 10" trees.
Animal Burrows and Washouts None.
Damage to slopes or top of dam None.
Cracked or Damaged Masonry Some deterioration at structure wall (Spillway)
Evidence of Seepage None.
Evidence of Piping None.
Erosion None.
Leaks None.
Trash and/or debris impeding flow NO.
Clogged or blocked spillway NO.
Other_____.

DAM NO. 6-11-220-2

Remarks & Recommendations: (Fully Explain)

Note several locations where surface water runoff from road has caused minor slope erosion. - No evidence of a drainage system.

Consideration should be given to prevent surface water from roadway from flowing over slopes.

13.

Overall Condition:

1. Safe ✓
2. Minor repairs needed ✓
3. Conditionally safe-major repairs needed _____
4. Unsafe _____
5. Reservoir impoundment no longer exists(explain)
   Recommend removal from inspection list. _____

DESCRIPTION OF DAM

DISTRICT 6

Submitted by A.H Lounsbury
Date July 16,1973

Dam No. 6-11-220-2
City/Town Norwood
Name of Dam Willett Pond

Location; TOpo Sheet No. 32A

✓Provide 8½" x 11" in clear copy of topo map with location of Dam clearly indicated.

Year built (UNK. Prior to 1915). Year/s of subsequent repairs UNK.

Purpose of Dam: Water Supply ____. Recreational ____.
Irrigation ____. Other Industrial.

Drainage Area: 2.85 sq.mi. 1826.5 acres.

Normal Pording Area: 210 Acres ; Ave Depth 10-12 FT.
Impoundment 760 Million gals; 2332 acre ft.

No. and type of dwellings located adjacent to pond or reservoir ____
i.e. summer homes etc. Estimate 24 & 30 year round

Dimensions of Dam: Length 850. Max. Height 20
Slopes: Upstream Face 10-15 (R.R Rap)
Downstream Face 25 & 40 (EARTH)
Width across top 27.

Classification of Dam by Material:
Earth ✓Hwy Embankment Conc. Masonry ____. Stone Masonry ____
Timber ____. Rockfill ____. Other ____

A. Description of present land usage downstream of dam: 100 Rural; ____ Urban.

B. Is there a stoage area or flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure YES ____. NO. ✓

WILLETT POND DAM

DAM NO. 6-11-220-2

to life and property in event of complete failure.

No. of people None.

No. of homes None.

No. of Businesses None.

No. of Industries None Type .

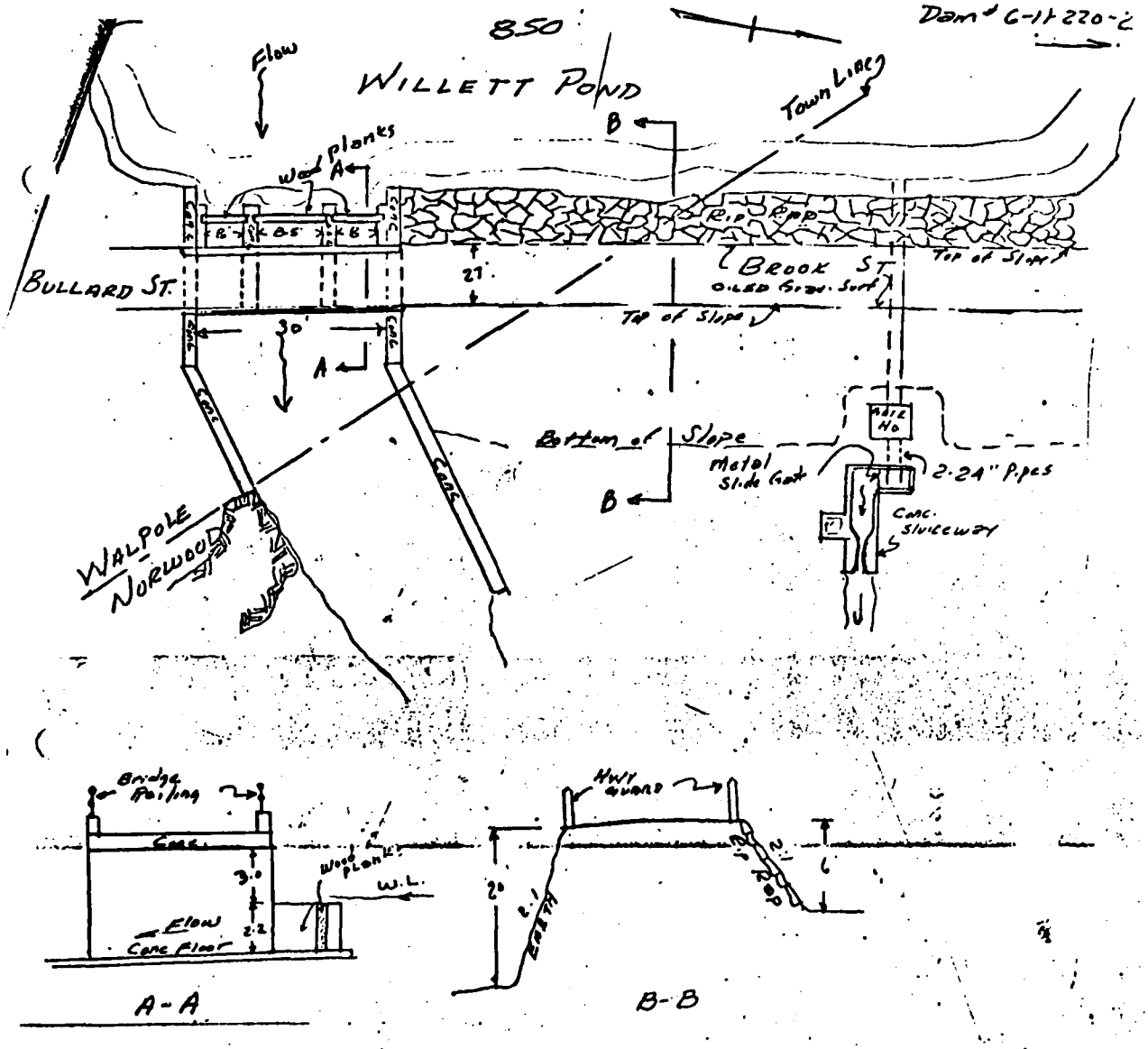
No. of Utilities None Type .

Railroads None.

Other Dams 6-11-220-4 6-11-220-1 6-11-220-3.

Other .

Attach Sketch of dam to this form showing section and plan on 8½" x 11" sheet.



WILLETT POND DAM

APPENDIX C

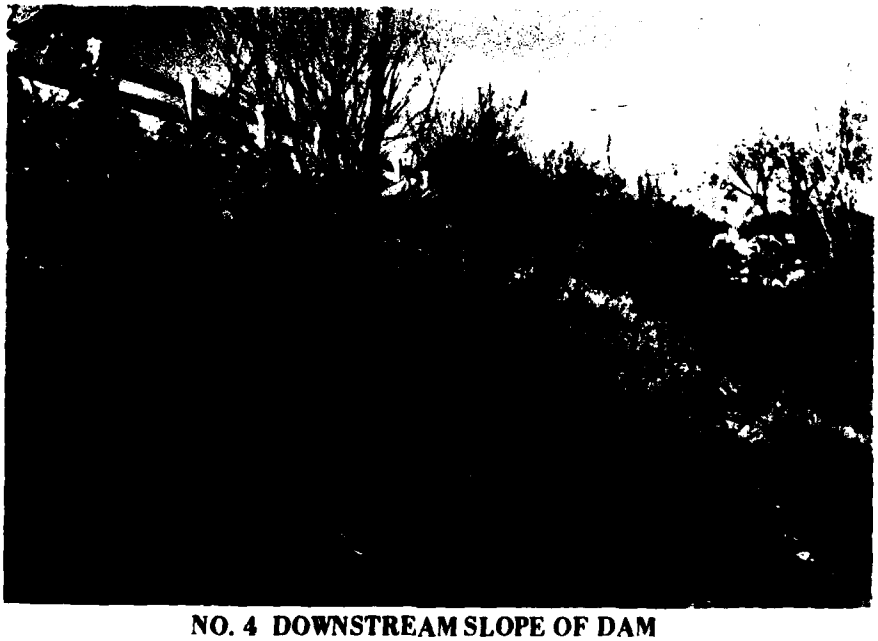
PHOTOGRAPHS

WILLETT POND DAM

NO. 1 CREST OF DAM FROM SOUTH ABUTMENT

NO. 2 UPSTREAM SLOPE OF DAM

NO. 3 UPSTREAM SLOPE AT SOUTH ABUTMENT

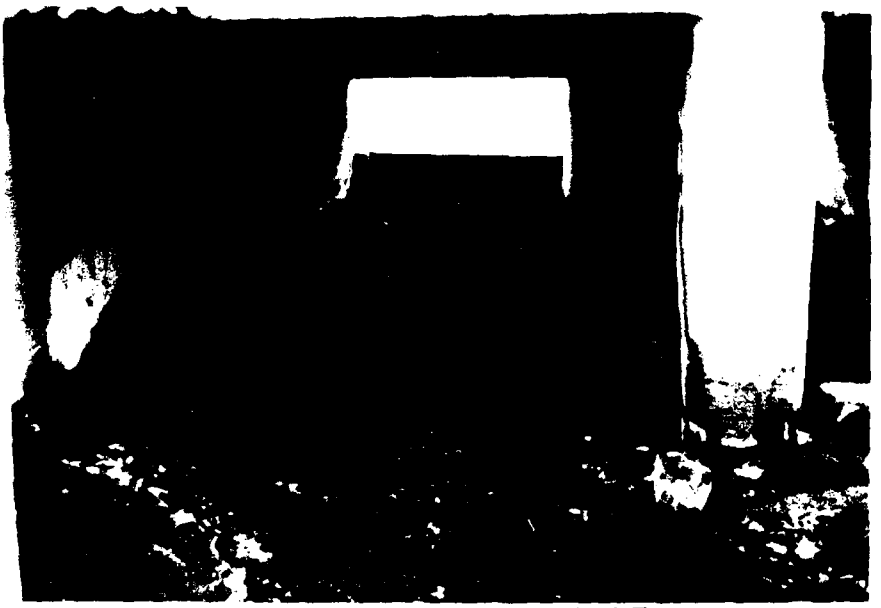


NO. 4 DOWNSTREAM SLOPE OF DAM

NO. 5 VIEW OF GATE HOUSE AND DISCHARGE FLUME

NO. 6 VIEW OF PARSHALL DISCHARGE FLUME

NO. 7 UPSTREAM VIEW OF SPILLWAY WITH FLASH BOARDS

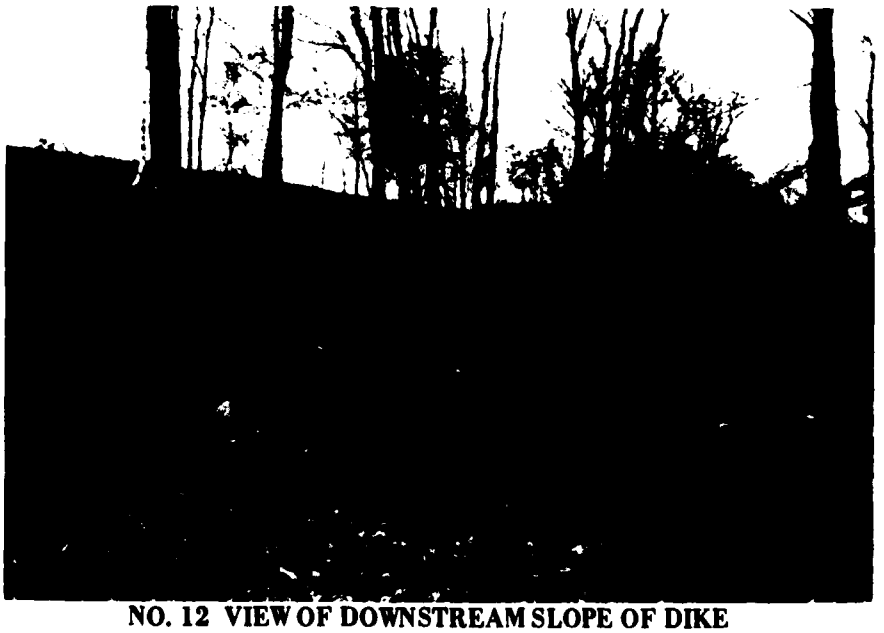


NO. 8 INVERT OF BOX CULVERT

NO. 9 UPSTREAM VIEW OF DISCHARGE CHANNEL

NO. 10 VIEW OF DIKE SOUTH OF DAM

NO. 11 VIEW OF UPSTREAM SLOPE OF DIKE



NO. 12 VIEW OF DOWNSTREAM SLOPE OF DIKE

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

FIG. D-1 DRAINAGE AREA MAP – WILLETT POND

Project Nat. Review of Non Fed. Dams Acct No. 6191 Page 1 of 6
Subject Norfolk County, Mass. Compld By LEB Date 12/21/78
Detail WILLETT POND Ck'd By [illegible] Date 14 MARCH 1979

(I) Test Flood, Storage & Storage Functions

1- Total Drainage Area - 5.55 mi²

2- Pond(s) Area: 0.31 + .04 + .02 = 0.37
Swamp(s) Area: 0.03 + .10 + .02 + .12 + .06 = 0.33
Total Area Pond(s) & Swamp(s): 0.70

% Ponds & Swamps = $\frac{0.70}{5.55}$ = 12 %

3- $\frac{410-139}{18,800}$ = 0.0144 } Say Ave Slope = 1.5%

4- Using C. of E. Curves for Peak Flow Rates & above guide values the Peak Flow Rate was estimated to be somewhat above "Flat and Coastal" and taken at 1000 c.f.s./mi²
Size Class: Interm. ; Hazard Pot.: High ; Spill. Des. Flood: PMF
Use: Test Flood = P.M.F.

5- **Test Flood Inflow = (1000) 5.55 = 5550 c.f.s.**

6- Pond Storage
The pond area is 0.31 sq. mi. at elev. .
Based on a const. area, storage increases at 200 ac. feet per foot of depth increase.

7- Spillway crest elev. is 137.7, top stoplogs is 139.0

8- Storage Functions are based on $Q_{out} = Q_{in}\left[1 - \frac{S_{out}}{R}\right]$

S_{out} = Storage Vol. in Reservoir related to final Q_{out} in terms of inches of rain over the drainage area.

S(in Inches) = $12\,D\left(\frac{0.31}{5.55}\right) = 0.67\,D$; R = 6hr rain of storm

D = Storage depth in feet above spillway crest in reservoir

9- Storage Functions: (Test Flood & ½ PMF - if needed)

$F_{TF} = 5550 - 292\,S = 5550 - 196\,D$
$F_{½\,PMF} = 2775 - 292\,S = 2775 - 196\,D$

METCALF & EDDY, ENGINEERS

(II) Discharge Ratings

A - Spillway (no stoplogs)

Gently rounded crest, Use $q = 3.12 H^{1.5}$
Ref.: V.T. Chow, "Open Chan. Hydr", pg 360-362
Crest Elev. 137.7, 3 openings - 8.25' wide each

Pond El.	138	139	140	141	142	143	144
q	0.5	4.62	10.9	18.7	27.8	38.1	49
Q_A	10	110	270	460	690	940	1220

B - Spillway (with stoplogs)

Use Williams & Hazen, "Hydr. Tables", $\phi = 30$, $L = 24.75'$
Present top of stoplogs elev. 139.0, Assume sharp edged

Pond El.	140	141	142	143	144
q	3.33	9.32	17.1	26.35	36.84
Q_B	80	230	420	650	910

C - Crest Flow

Use $q = 2.55 H^{1.5}$, Ref.: V.T. Chow, "Op Chan Hydr." pg 52-53

Q_1: 280' @ 142.15 ; Q_2: 670' @ 142.35

Pond El.	142.5	143.0	143.5	144
Q_1	150	560	1120	1800
Q_2	100	900	2100	3620
ΣQ_c	250	1460	3220	5420

D - Low Level Outlet

2 - 20" ϕ Pipes ; Lower Elev = Top Pipes = 120.7 = due to flume backwater
H_D = Pond El. - 120.7 = $V^2/2g$ (2.2) = Ent. .5, Exit 1.0, Valve 0.5, Fric 0.2
Total Area = 4.36 ft² for 2 pipes $Q_D = 23.6\sqrt{H_D}$

Pond El.	136	137	138	139	140
H_D	15.3	16.3	17.3	18.3	19.3
Q_D	92	95	98		

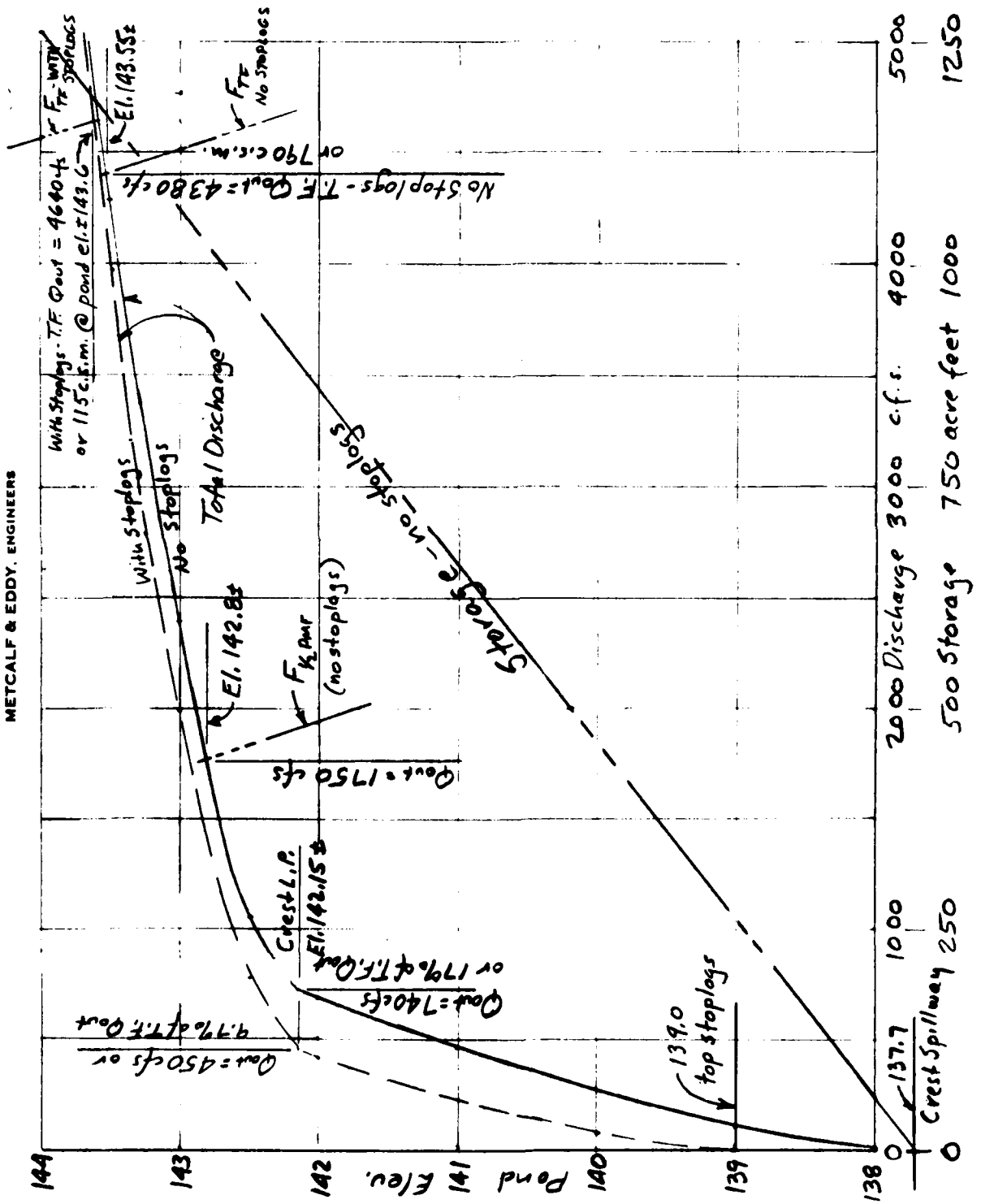
Time to lower pond 2 feet @ Pond @ 137.5 = $\frac{200(47560)}{3600(95)} = \pm 25$ hr.

Project Nat. Review of Non Fed. Dams Acct. No. 6191 Page 3 of 6

Subject Norfolk County, Mass. Comptd. By L&B Date 1/17/79

Detail WILLETT POND Ck'd. By [illegible] Date 14 March 79

(III) Discharge, Storage & Storage Function vs Pond. Elevation



METCALF & EDDY, ENGINEERS

(IV) Maximum Crest Flow

A- No Stoplogs

Max Depth: 143.55 − 142.0 = 1.55' (142.0 is minor low pt.)

$q = 2.55(1.55)^{1.5} = 4.92$ cfs/ft

As critical flow:

$y_c = 0.91'$, $V_c = 5.4$ fps

B- With Stoplogs

Max. Depth: 143.6 − 142.0 = 1.6'

$q = 2.55(1.6)^{1.5} = 5.16$ cfs/ft

As critical flow

$y_c = 0.94'$, $V_c = 5.5$ fps

(V) Temporary Pond Lowering

Lower pond before remedial work, to allow passage of 100 yr storm, (taken as ½ PMF) via spillway and low level outlet w/out overtopping

$\therefore Q_{out} = 740 + 95 \approx 835$ cfs. ; $Q_m = \frac{1}{4}(5550) = 1390$

Using Storage Funct.: $Q_{out} = Q_{in} - 196\, D_T$

$835 = 1390 - 196\, D_T$; $D_T = 2.8$ ft.

Min Crest eleu. = 142.1 ±
less "D_T" = 2.8
Eleu. 139.3 - Temporary max. pond eleu.

Project Alat. Review of Nmn Fed. Dams Acct. No. 6191 Page 5 of 6
Subject Norfolk County, Mass. Compld. By LEE Date 1/17/79
Detail WILLETT POND Ck'd. By [illegible] Date 14 March 79

(VI) Failure of Dam - at Main Dam

Peak Failure Flow:

Pond Elevation - 142.1 (T.P. on Dike)
Toe Elevation — 122.0 (Toe Main Dam)
Y_o = 20.1'

Dam Length Subject to Breaching = 384
$W_o = 40\%(384) = 153.6$

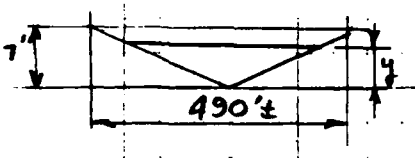
$$Q_{P_1} = 1.68\, W_o\, (Y_o)^{1.5} = 1.68(153.6)(20.1)^{1.5} = 23{,}250 \text{ c.f.s.}$$

Spillway Flow w/Pond El. 142.1 = 740 c.f.s., Total Flow ≈ 24,000 c.f.s

Storage Volume Released:

Storage Above Spillway : 4.5 (200) = 900 ac. ft.
Storage Below Spillway : ⅓ (15.6) 200 = 1040 " "
S = Total Storage = 1940 " "

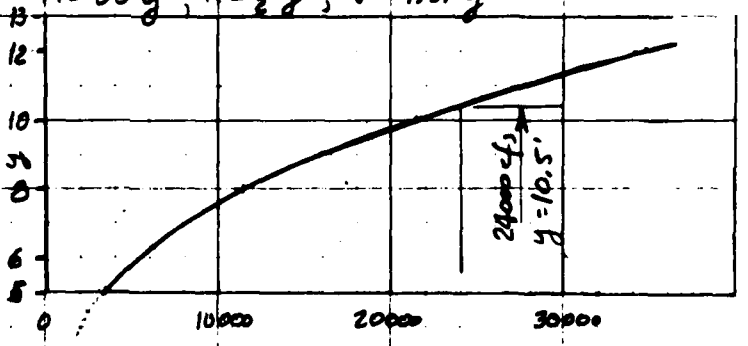
Channel Hydraulics:



$n = 0.08$, $S = \frac{10}{800}$, $V = 2.08\, R^{2/3}$

$A = 35y^2$, $R \approx \frac{1}{2}y$, $V = 1.31\, y^{2/3}$

y	A	V	Q
5	875	3.83	3360
10	3500	6.09	21310
12	5040	6.88	34650
8	2176	5.25	11420
2	140	2.08	291
4	560	3.31	1850



Failure flow at 10.5'± depth & velocity of 6.2± fps.

Prior flow at about 3' depth & velocity of 2.6± fps.

Time to Drain:

$$\frac{43560\ (1940)}{3600\,(\frac{1}{2})\,(23{,}250)} = 2.02 \text{ Hours.}$$

METCALF & EDDY, ENGINEERS

Project Nat. Review of Nonfed. Dams Acct. No. 6191 Page 6 of 6
Subject Norfolk County, Mass Compt'd. By LEE Date 1/17/79
Detail WILLETT POND Ch'k'd. By REK Date 14 March 79

(VII) Failure of Dam - at Dike

Peak Failure Flow:

Pond Elevation - 142.1 (L.P. on Dike)
Toe Elevation — 128.7 (L.P. on toe of Dike)
Y_o = 13.4 ft

Dam Length Subject to Breaching = 140' (Vic. of Toe L.P. & Elev 142.1±)

$W_o = 40\%(140) = 56$

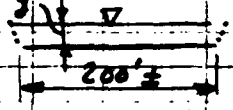
$Q_{P_1} = 1.68\, W_o (Y_o)^{1.5} = 1.68(56)(13.4)^{1.5} = 4600$ cfs

Spillway Flow @ Pond El. 142.1± = 760 cfs - NOT ADDITIVE TO FAILURE FLOW

Storage Volume Released:

Storage Above Spillway: 4.5(200) = 900 ac. ft.
Storage Below Spillway: ⅓(8.9)(200) = 890 " "
S = Total Storage = 1790 " " (above pond bottom)

Channel Hydraulics: Discharge Overland



$S \approx \frac{10}{300}$; $n \approx .07$, $V = 3.0\, R^{2/3} \simeq 3.0\, y^{2/3}$

y	A	V	Q
2	400	4.78	1910
4	800	7.58	6060
3	600	6.26	3760
3.5	700	6.94	4860

As calculated, dike failure produces flow about 3½ feet deep with a steady flow velocity of 6.9 fps. Numerous residences would be effected. Closest about 200 feet from dike.

Time to Drain:

$$\frac{43560\ (1790)}{3600(\frac{1}{2})(4600)} = 9.4 \text{ Hours.}$$

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

WILLETT POND DAM